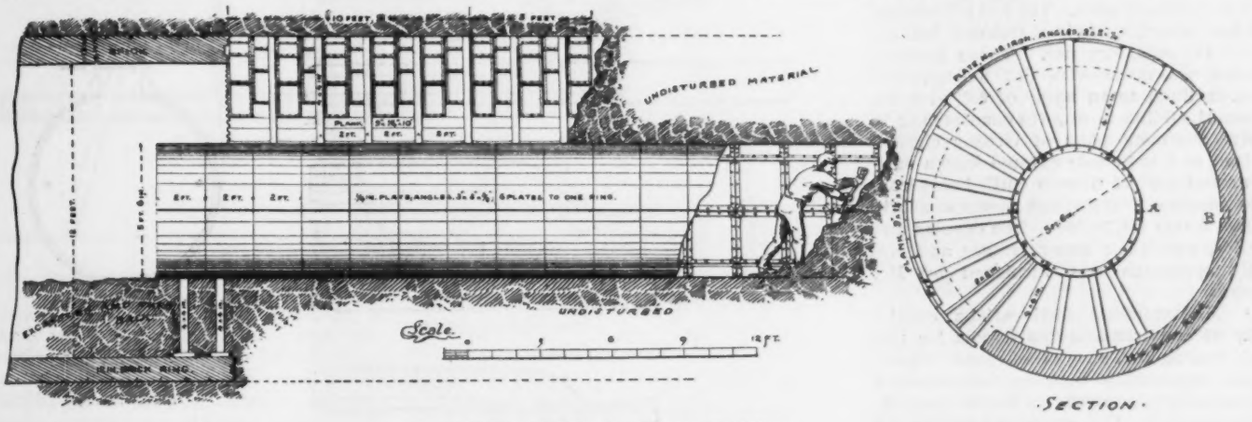
A New Method of Sewer Building.

The city of Brooklyn is just completing the Knickerbocker Avenue extension sewer, intended to drain an area of about 2,800 acres of low land lying about the head of Newtown creek. This sewer, in running through South Fifth street reaches a depth at some places of 50 feet below the street surface and passes through a soil which is mainly loose, dry sand. The contract for this part of the work was originally let to Mr. Charles Hart to be constructed by an open cut; but as the street is narrow and thickly built up, the residents entered a decided protest, fearing the undermining and destruction of their property as a result of the open cut process. And to further complicate matters, the insurance companies threatened to cancel all policies on the houses abutting on this street if any attempt was made to prosecute the work on the original plan. In this emergency, Messrs. Anderson & Barr made a proposition to tunnel the street by a process of their own, and as the contract was already let to Mr. Hart, the engineering authorities of Brooklyn advised Mr. Hart to associate himself with the firm named and to carry out the work under their process. This arrangemant was made, and this difficult work was carried to successful completion by the method which is about to be described.



A New Method of Sewer Building.

The total length of the sewer under this contract is 5,400 feet; the street through which it runs is narrow, substantially built up on both sides, and contains already a system of sewers and water distribution, The purpose of the new sewer being mainly to drain the district bordering on the Newtown Flats, into the East river, it had necessarily to pass far beneath the existing sewers, the deepest point of the invert being 50 feet below the street surface, ranging from that to 30 feet in the lower points. A tunnel seemed to be the only feasible method of constructing the work, but as the soil to be penetrated was over the greater part of its length a fine, dry, running sand, this plan was not without risk to the neighboring buildings under any of the usual system of tunnel-driving.

The contract for the work was let, however, to the above firm about April 15, 1885, and they commenced operations upon plans of Mr. John Anderson, formerly superintendent of the Hudson River Tunnel, and these plans we will now describe.

The inside diameter of the sewer was to be 12 feet, circular in section and with a brick ring, 12 inches thick. Of the total length, 3,925 lineal feet is in tunnel, the remainder having been taken out as an open cut. The chief feature of this new system in sewer construction was the application of the pilot-tunnel first devised and used by Mr. Anderson at the Hudson River Tunnel. The illustration explains the position of this pilot with reference to the tunnel proper. In construction it was a cylinder 5 feet 6 inches in diameter and made up of plates, six to one complete ring, and 2 feet wide; though half-plates in width were used in very bad material. These plates were made of ¼-inch boiler-iron and were connected together by inside flanges formed of 3 × 3 × ⅜-inch angles riveted to the plates, and bolted together. Fastened to one *end* of each segment was a plate 4 × ⅜-inch, which projected 1 inch outside the surface of the completed cylinder. These projections, running as they did in continuous lines from end to end of the pilot, formed heels or supports for the timbering, etc., to be further described.

This pilot-tunnel was kept with its forward end constantly from 10 to 15 feet ahead of the main excavation, and was thus always well supported at that point. This was accomplished by men working inside of the pilot and putting the forward plates in place successively commencing with the crown, the excavated material being thrown into the finished tunnel at the rear end of the pilot. The back of the pilot was supported, as shown, on a double set of 4 × 4-inch struts resting on the completed brick work over which the pilot always lapped about 3 feet. The earth thrown back and, for the time, the earth under the whole length of the pilot, also aided materially in supporting this appliance.

The brick-work was carried forward in sections of 10 feet in length. But to first remove the material a support was required for the roof and sides that should be made up of members readily handled and that were sufficiently strong to prevent all settlement or escape of the soil. In this case the roof was made of plates with inside, bolted flanges. These plates were 3 feet long each and 2 feet wide in the ordinary earth or hard-pan portions of the tunnel and only 12 inches wide in the sand. Each plate was made of No. 12 iron with 2 × 2 × ¼-inch angles riveted to them. The plates broke joint, so that there were six in one ring and five in the next. The crown plate was first put and supported from the top of the pilot by a 4 × 4-inch brace; and then the side plates were successively put in position, bolted to the adjoining plates and propped as shown in the section. If any unusual pressure appeared, a 2-inch plank was first laid against the plate over the strut to better distribute it.

When the roof-plates were in position the sides and bottom were held by planks 9 × 1¼-inch by 10 feet long each. As each plank was put in place it was temporarily secured by 2 × 2-inch struts, (as shown) until three planks in width were in position, when a short length of 2 × 10-inch plank was set and propped by a 4 × 4-inch strut as in the iron plating. In removing the material from under the pilot, connection was first made between the two sides nearer the forward end of the pilot and the excavation was then pushed towards the near end. The reason for this manner of working is, that the pilot must now act as a beam to support the weight above, and while the front end is well held by the undisturbed soil, it is advisable to leave the rear support as long as possible. The great advantage of this system, when it comes to the brickwork, is that as will be seen, the invert is entirely free from any obstructing timbers as far as the 10 feet working length is concerned; the light, easily handled struts can be removed as the brick is laid, and if there is the slightest tendency to deformation in the brickwork these struts can be replaced on top of the brick. The tunnel itself can be braced inside to resist any extraordinary local pressure.

As soon as the excavation is completed over a section 10 feet ahead of the finished tunnel, the brickwork is commenced in that section. The invert is laid as usual without any trouble, and in turning the upper arch, centers made of wrought-iron T-ribs, were used. These ribs had shoes riveted to them and they rested on a short timber which was supported by the center projecting rib on the pilot (at *A*) at one end and in put-lock holes (*B*) left in the brick masonry at the other; ordinary lagging was then placed on these ribs. It is understood that the iron plates in the roof and the plank at the sides and bottom, if the bottom is bad, are all bricked in and left there. (The illustration is incorrect in this particular as it shows plates on the bottom as well as at the top of the finished work.)

As this method of tunnel excavation was novel, considerable experiment was necessary before everything was in working order. The work was commenced about the middle of April, 1885, but as mentioned a portion of the work was constructed in open cut and shafts had to be sunk, etc. The following table of progress will speak for itself.

For the Month Ending.			*Lineal Feet.*
May 1,	1885	the work done was	40
June 1,	"	" "	113
July 1,	"	" "	165
August 1,	"	" "	159
Sept. 1,	"	" "	120
Oct. 1,	"	" "	203
Nov. 1,	"	" "	227
Dec. 1,	"	" "	399
Jan. 1,	1886	" "	377
Feb. 1,	"	" "	495
March 1,	"	" "	600
April 1,	"	" "	606

During the latter months when the greatest progress was made there were two shafts and four working headings. The work was carried on in double shifts of 10 hours each. The longest drive in one week from four headings was 170 lineal feet of tunnel completed.

Sea Coast Fortification in Holland.

Ever since 1881, Holland has been at work fortifying its sea coast at Helder, at Ymuiden, the mouth of the Amsterdam-to-the-sea canal, and at Maasmunding, the mouth of the Rotterdam-to-the-sea canal.

At the Helder, the old fortifications were remodelled and simplified, and a new fort, Fort Harssens, was built. This new fort contains two cupolas, each for two breech loading guns of 30.5-c. m. (12.0-inch) caliber, and 37 tons weight, each. The running load of each cupola is 713 tons. The cupolas are of Gruson chilled iron; and they, the gun-carriages and their hydraulic apparatus were supplied by Mr. Gruson, of Backen-Magdeburg, Germany.

The Ymuiden fortifications consist mainly of one iron-casemated battery of four breach-loading 12.0- c. m. (4.7-inch), guns, and one iron-armored cupola for two breach-loading 15.0-c. m. (5.9-inch) guns. The fort is protected from land attack by an iron-armored flanking gallery for musketry use. These flanking galleries are made with flat wrought-iron plates, inclined to an angle of 60° with the horizontal, sliding in grooves countersunk in massive abutment piers of Gruson chilled-cast-iron, and the whole covered with a massive arched roof of Gruson chilled-cast-iron. These Ymuiden fortifications have cost nearly 4,000,000 florins ($1,700,000). The cupolas and batteries, with their gun-carriages and hydraulic apparatus was furnished by Mr. Gruson.

The Maasmunding fortifications consist mainly of one iron-armored cupola for two breach-loading 24-c. m. (9.4-inch) guns to meet all sea approaches with an iron-armored flanking gallery for musketry fire to sweep all land approaches. The cupola and gallery are similar to those of Ymuiden and the chilled-cast-iron work was all furnished by Mr. Gruson.

The cupolas aud batteries are now completed and have all been tested by the actual manœuvring and firing of their guns, both separately and in salvos. In the Ymuiden casemates, the revolution was so slight that with all the casemate windows close behind guns and with all four guns fired at once, the only apparent danger was the breaking of our small panes of window glass. The masonry arches of the casemates under the guns, with a thickness at the key of 1.2 metres (46-inch), stood admirably under the severe salvo test.

At all the forts, the hydraulic buffers were made with cylinders of cast-iron. For the 12.0-c. m. (4.7-inch) and 15.0-c. m. (5.9-inch) guns, the cast-iron cylinders proved sufficiently strong; but for the 24.0-c. m. (9.4-inch) and 30.5-c. m. (12.0-inch) guns the cast-iron proved too weak and is to be replaced by cast-steel. With these slight exceptions the cupolas, batteries and armament responded admirably and successfully to the various severe tests to which they were subjected. The inclined flanking-galleries are now being constructed at Ymuiden and Maasmunding.

The Dutch officers, sent to Buchaust to witness the $120,000 competitive tests between the Gruson cupola and the Morgin (French) turrets, have returned enthusiastic as to the superior resistance and simpler manœvre of the Gruson cupola.

CHARGES FOR CITY SURVEYING.—City Engineer Steyh made a recommendation in his annual report which ought to be acted upon at once. The city now charges $2 for the services of the engineer in surveying a lot. This sum is entirely too small. Many lots require from half a day to almost a full day's time for such work, and furthermore an assistant must be employed. A competent engineer should receive at any rate not less than $4 per day for his services. Mr. Steyh's assistant costs less than this much each day, but his services costs something, and on almost any job of survey done by the engineer and this man the $2 received therefor amounts really to only a fraction of the actual expense. While the city does not, perhaps, want to make any money on this work, it should aim to come out even on it.—Burlington, Io., *Hawkeye*.

Municipal Engineering; Paper No. 2.*

PROVIDENCE, RHODE ISLAND.

(*Continued from Page 259*).

Tools used in Laying Pipe, etc.—A set of tools used in calking pipe joints is shown on Plate 4. They consist of a hammer, a yarn iron for packing the gasket into the joint, five calking irons for driving the lead ranging from 1-8 to 1-2-inch in thickness, (only the two extreme sizes are shown on the plate), a cold chisel for trimming the lead, etc., a chisel faced hammer, and a diamond chisel for cutting pipe. On the same plate is shown the style of clips used in making the joints of the larger sized pipes, from 16 to 36 inches in diameter, for enclosing the space left in the socket for the lead. These clips are fitted close up to the bell, and to render them more efficient the cracks between them and the pipe are plastered over with moist clay, a quantity of the same material being used for enclosing a space left at the top for pouring the lead into the joint. After the lead has been poured and become sufficiently cool, the clips are removed and the joint is ready to be calked. In connection with the clips. when full joints are made, (joints without using yarn gasket), which are calked from the inside as well as the outside of the pipe, an iron ring is used on the inside of the pipe. All of the pipe joints on the Providence Water Works, however, with the exception of the first of the two lines of 36-inch force mains that were laid, have been made with gasket joints, that is, joints in which yarn gasket is packed to a proscribed depth before the lead is poured.

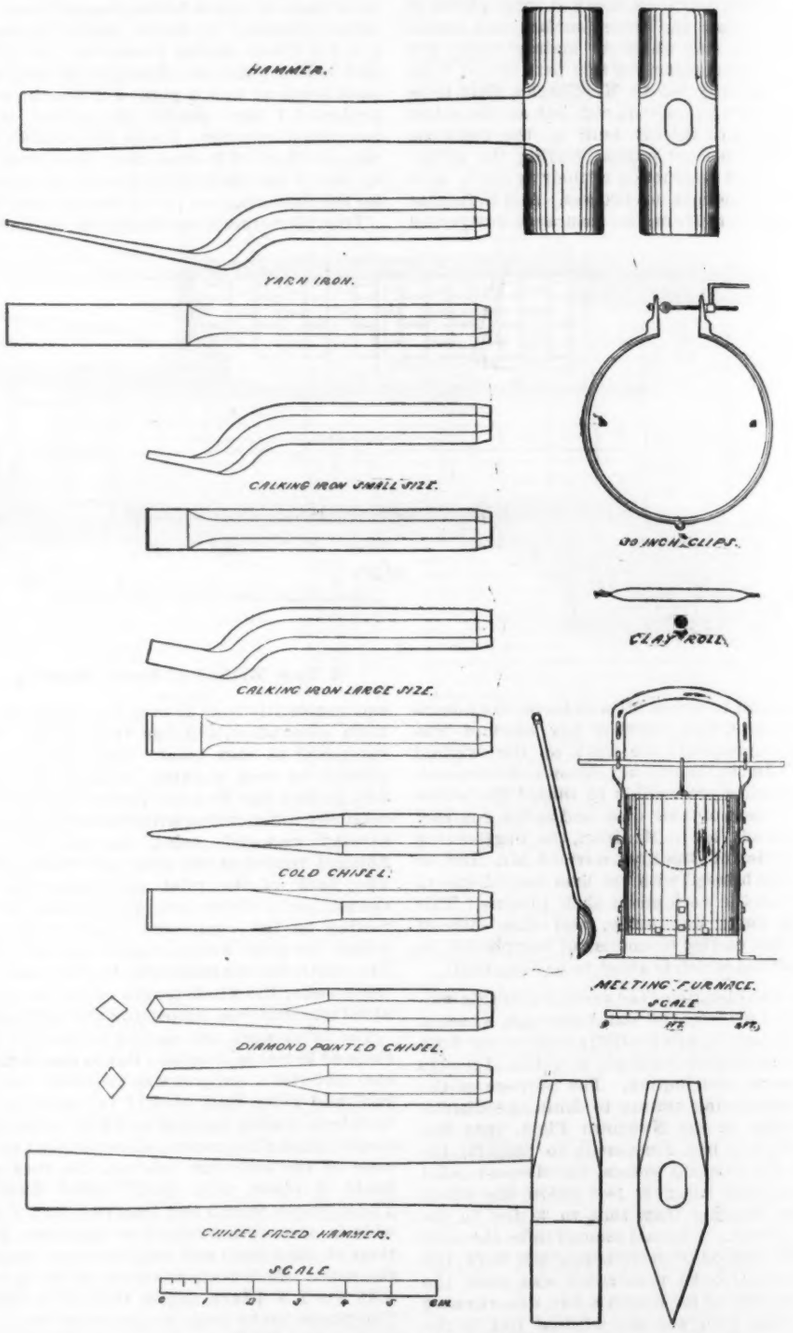


Plate 4.—Tools used in Pipe Laying.

For filling the joints of the smaller sized

---

* Copyrighted by ENGINEERING NEWS PUBLISHING CO., 1886.

pipes, from 6 to 12 inches in diameter, a roll is used, which is made by wrapping moist clay around a number of strands of yarn. The pipe is encircled with this roll, which is pressed tightly up to the bell, leaving only a small opening at the top for pouring the lead.

Plate 4 also shows a general style of furnace for melting the lead. The shell or exterior is

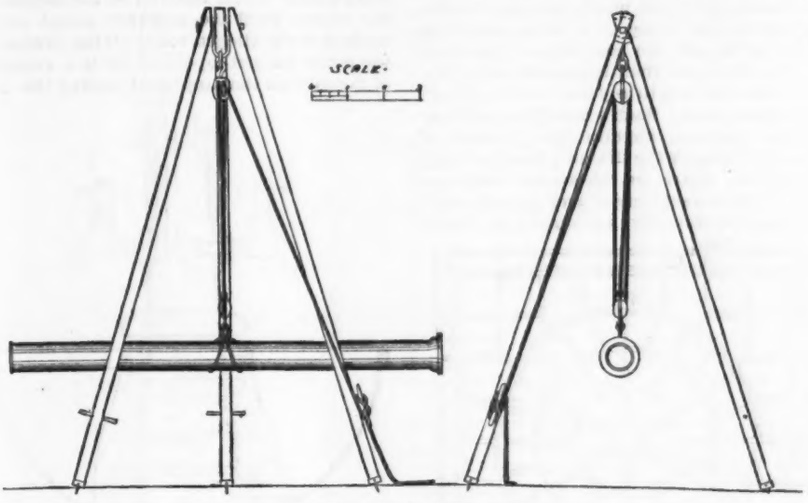


Plate 5.—Pipe Derrick.

made of 1-4-inch boiler iron. There is a grate at the bottom which rests upon two rods running from side to side. The hooks on the outside of the furnace are employed in transporting it, a bar being placed under each. There are also two sets of hooks on the frame at the top for supporting the kettle bar.

Plate 5 shows a style of derrick used in laying 6 to 12-inch pipe. For laying larger sized pipe a similar style is used with a hand winch attached to it.

Valves and Covers.—Plate 6 shows the kind

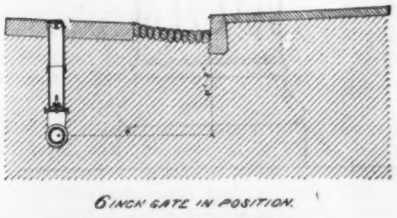


Plate 6.—6-12-in. Valve box.

of boxes used with 6 to 12-inch valves, and Plate 7 shows the kind used with 16 to 36-inch valves. The boxes and covers in both instances are made of cast iron. Valves are set on

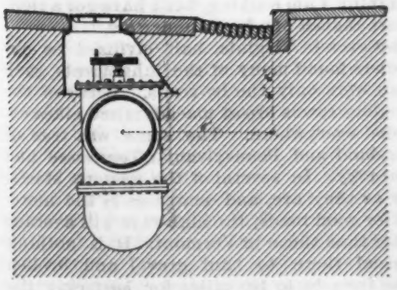


Plate 7.—16-30-in. Valve box.

the larger distribution pipes about 1,000 feet apart; they are also set on all pipes leading from those of a larger diameter. The number set on the whole distribution system averages one gate to about 500 feet of pipe. When possible they are set at street corners on the range of one of the occupation lines.

Fees for Connecting or Tapping Mains.—The city furnishes and lays the service pipe free of charge from the main pipe in the street to a point one foot inside the stop in the sidewalk.

Water Meters, Number in Use, etc.—On December 31, 1885, there were in use 6,648 water meters, as follows:

Ball & Fitts, piston	3,609
Ball & Fitts, rotary	63
Crown	2 678
Fales, Jenks & Sons	187
Worthington,	111

An illustration of the manner in which meters are frequently set is shown on Plate 2. In this instance the meter is shown set in a pit below the cellar floor, to prevent it from freezing. As an extra precaution in this respect, tan bark or plasterer's hair is sometimes filled in around the meter. A stop cock is located between the meter and the cellar wall next to the street, which is arranged with a waste so that the water can be shut off from the street and the meter and the service pipe in the building emptied at the same time. The size of the service pipe laid in the street from the main to the sidewalk governs the size of the meter, unless in exceptional cases, that is to say a 5-8-inch service calls for a 5-8-inch meter, etc. The meters are owned by the consumers, but they are set by employés of the board of public works.

No system of waste detection is in use, and has not been considered necessary, as the consumption of the city, including waste and leakage, has always been considered as small for a city of its size.

Pavement Stop Cocks.—The service taps and stops used are made of composition. Plate 8 shows a 5-8-inch size and Plate 2 the method of setting.

House Inspection.—There are two men employed continually to read meters, with additional help when required. These men also act as inspectors to see that the regulations of the board of public works are complied with.

Special Castings.—Special castings from 8 to 12-inch are of similar design. Those of larger sizes are also similar with the exception that curved pipes, the lengths of which are governed by the requirements of the case, are altogether used for turning angles.

"Lugs" are cast on specials for the purpose of fastening them together, or to the bells of the pipes with which they are connected by the aid of straps. It is very rarely considered necessary to do this however. Only one class of specials are employed, which are made of sufficient strength to be used with all the classes of pipes corresponding to their respective diameters.

Signs used on Streets in Connection with Water Service.—The cover of the service pipe boxes (Plate 3), of the old style are designated by an *S*, and of the new lock style by *P W W*.

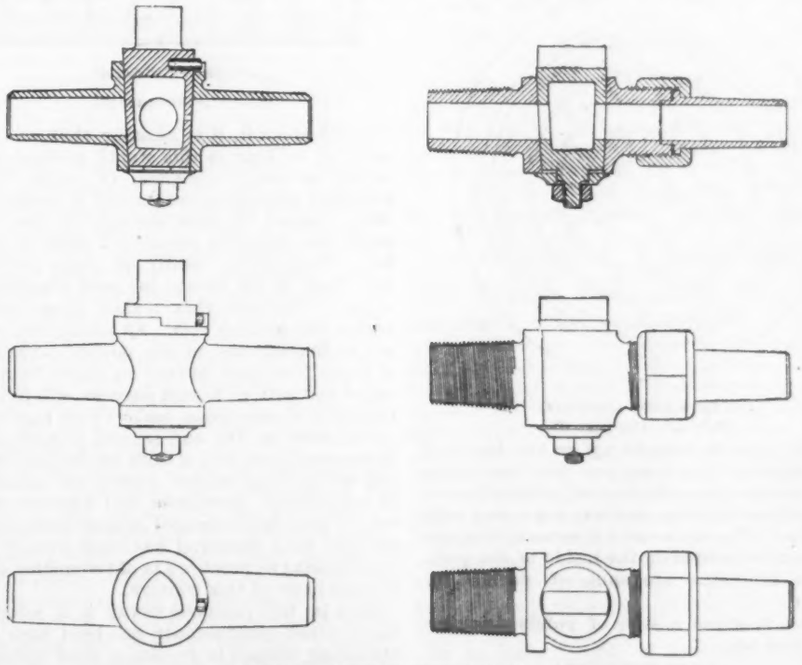


Plate 8.—Service Taps and Stops.

The valve box covers (Plates 9-10) are distinguished by a *V*, and the blow off boxes by a *W*.

There are no special signs used to designate hydrant boxes, with the exception of the peculiar construction or design of their covers, which are readily recognized by any one familiar with them. (See Plate 11). When hydrants are not set on street corners or when the location is not well defined, a piece of tin with a large *H* painted on it is sometimes

nailed on to a fence or some convenient place near by as a reference.

Number of Miles of Pipe Laid.—There were

BLOW OFF COVER.

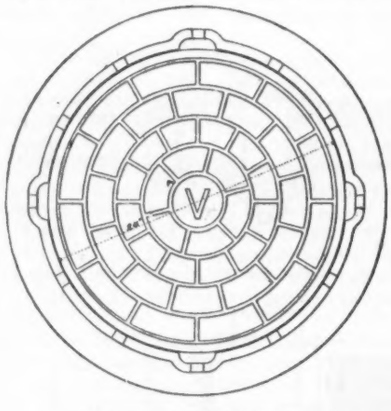
VALVE BOX COVERS, SMALL SIZE.

Plate 9.—(See page 275.)

laid to December 31, 1885, 189.30 miles of water pipe of the following sizes:

INCHES.	MILES.	INCHES.	MILES.
6	123.91	20	1.30
8	26.82	24	4.53
10	2.80	30	11.29
12	10.77	36	1.91
16	5.98		

Drinking Fountains.—Plate 12 shows a style of public drinking fountain in use. The water



VALVE BOX COVER, LARGE SIZE.

Plate 10.—(See page 275.)

supply pipe is brought up on the inside of an ordinary iron lamp post (not interfering with the gas pipe), the two self closing faucets are screwed into the post and connected with the pipe. The waste water flows away through a pipe also located on the inside of the post. These fountains are shut off during the winter.

Plate 13 shows a style of public drinking trough in use.

(TO BE CONTINUED.)

Gravel Roads. Correction.

TERRE HAUTE, IND., April 26, 1886.

EDITOR ENGINEERING NEWS:

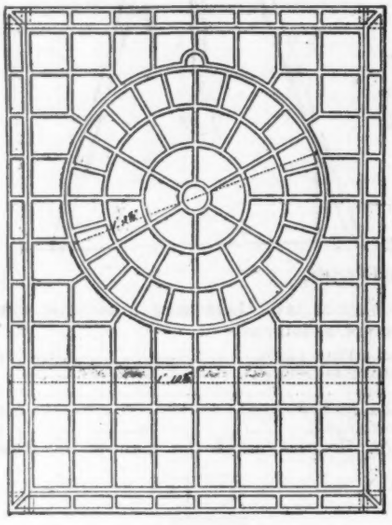
I notice the following principal typographical error in the paper on "Gravel Roads" printed in your last issue, April 24, page 261, 12th line 17.6 *should be* $\frac{1}{7.6}$, 14th line 131.3 *should be* $\frac{1}{31.3}$. Page 262, 3rd column, 10th line of paragraph on Pipe Culverts, brick *should be* 1 inch, 8th line from bottom, wall *should be* well. Respectfully,

C. C. B.

The errors were in the copy from which you took the article.

Good Roads.

Vermont has been settled more than one hundred years, and yet most of the highways are no better than they were fifty or seventy-five years ago. They are dirt roads. It may be doubted if there are ten miles of stone road in the state, even including the paving and macadam in the most populous centers. In many regions owing to a large admixture of clay in the soil, the heaviness of the roads in wet weather and their roughness when dry, makes life a burden to any man who is obliged to use them much. Such a condition seriously impedes business, impairs the pleasure of driving, endangers the life and health of delicate people, wears out horses and carriages and discourages settlement and sojourn amid our otherwise attractive surroundings. Come



HYDRANT COVER.

Plate 11.—(See page 275.)

to think about it, it is amazing that we have gone on so long in this stupid endurance of an evil so easily overcome. Of course there are many sections where the soil is leechy, or where gravel or slate abound, so that the roads are generally passable in spite of neglect. They might easily be made perfect. But there is no excuse for poor roads anywhere. The soil that makes them heavy makes the farmers rich. An outlay that will not be burdensome to the poorest taxpayer, if made from year to year on scientific principles and with an honest purpose, will in less than half a generation make every highway in the state as dry and smooth in April and November as the best of them are now in June. But we have had neither science nor honesty in our system. Selectmen and highway surveyors have been changed almost yearly and not one in a thousand has made a study of road-making as practiced in old countries and in some parts of this country.

Even in the populous towns it is seldom that a street commissioner has been kept in office long enough to develop a good system, or been furnished with money enough to build permanent ways. In most places a majority of the taxpayers have worked out the tax. They have had an annual picnic, and the chief sport has been to see who could leave the largest sods in the road or kill time in the most entertaining manner with stories. In some of the larger towns this class of public work has afforded a sort of pension list for men "unable to earn a living at manual labor," and has yielded patronage to political bummers. Engineering has been practically unknown. Alignment, grading and drainage have been disregarded. Even in so important a town as Rutland, the principal business street has been allowed to be encroached upon by buildings which mar its uniformity and may some day obstruct its traffic. Nearly all the streets are seas of mud for a month in autumn and two months in spring. A few days ago a lightly loaded wagon became stalled near Center Rutland by the sinking of the wheels until the axle-tree rested on the surface of the alleged road. What became of the horse was not reported. It is a reminder of the cartoon that appeared during the war,

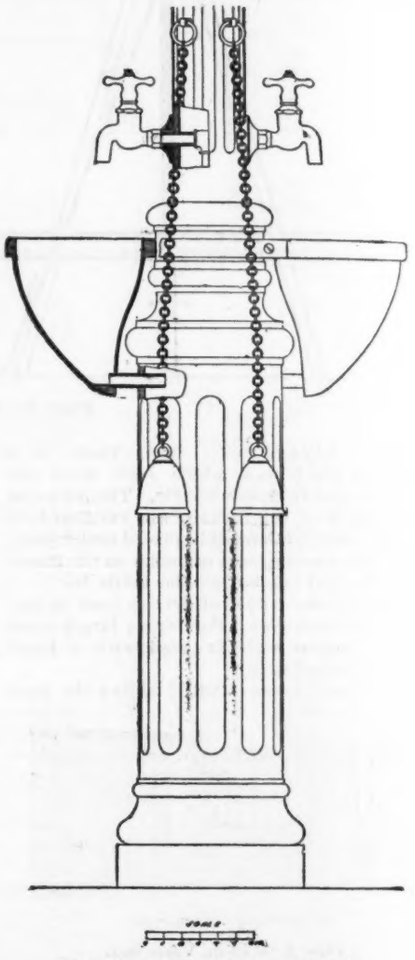
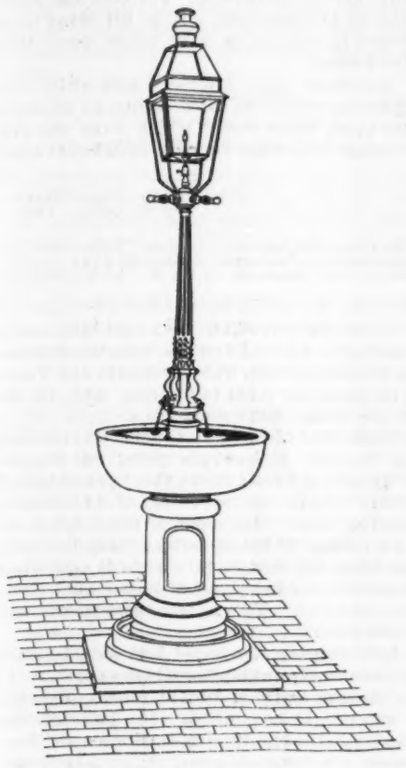


Plate 12.—Public Drinking Fountain.

in which a soldier was seen approaching waist-deep in mud, holding what appeared to be bridle rein in his left hand, while he shouted to his comrades on an "island," "Perhaps you think I am walking, but I have got a right smart chance of a horse under me."

But even in Virginia, half civilized as our soldiers found many of the inhabitants, such roads were only the by-roads. Between the populous towns broad macadamized pikes extended everywhere. The same was true of Maryland and Pennsylvania, Tennessee and Kentucky. In several of the western states, new as they are, and scarce as is the material for good roads, the highways will average better than those in Vermont. It is nothing unusual there to haul gravel and broken stone from 10 to 100 miles for surfacing the roads, and hundreds of miles of tiles have been laid for carrying off the accumulations of water underneath the roadbed. This method of under-drainage is the first essential of good roads. That done, and proper grades secured, the surfacing will cost very little except where the traffic is so heavy as to require paving or macadamizing. By entering upon a

proper system and adopting a permanent policy, any town and village can, even with the present annual outlay, secure good roads in a few years. But it will be far better to double or triple the road tax for awhile, and



DRINKING TROUGH.

Plate 13.—(See page 276.)

thus do the work more economically and efficiently. No other public expenditure save that for the common schools will be so highly appreciated or yield such returns of profit and enjoyment.—Rutland, Vt. *Herald.*

THE law as to dilapidations is rather rigorous in France, and more especially in Paris. In the Code Napoléon (B. III. T. VIII.) the duties of a tenant are prescribed with the usual decision of that work. Landlords also have their duties, and the arrangement between the parties is a source of trouble as well as of expense. An assurance society with the title "Bâtiment de Paris" has been founded for the purpose of making things easy to the subscribers. The annual payment of a settled sum (varying according to the character of the building) will make the society responsible for carrying out the repairs that are incumbent on owner or on the occupier, or, in other words, there is protection given against dilapidation in every form, in the same way as there has been against fire. The work is to be done by the society's staff, and the saving is expected to be an inducement to the public to become subscribers. It is a new form of co-operation of which the results will be watched with interest. The society will have one advantage at least, for, with a body of that kind, landlords who are prone to exact too much from tenants, and tenants who are never satisfied, will have to be content with what is equitable. There is room for a similar society in this country. *The Architect.* (London.)

D. F. MINAHAN Contractor, Lima, Ohio is just starting up at that place, and is in want of 100 good teams.

Shrinkage of Earthwork.*

BY P. J. FLYNN, M. TECH. SOC.

Some years since experiments were made in Dharwar, in India, by Mr. J. H. E. Hart, C. E., on the shrinkage of earthwork, and the results of these experiments agree with the results arrived at by Mr. Specht (Transactions Technical Society, May, 1885), namely, that the embankment, at first, gave a volume larger than that of the pit from which the material with which it was constructed was excavated.

Mr. Hart had three pits excavated, and the material from each pit was formed into a bank. The first pit, in black cotton soil, was $49' \times 4\frac{1}{2}' \times 2' = 416$ cubic feet. This was formed into an embankment which measured $50' \times 6' \times 2' = 600$ cubic feet. After the bank was measured some of the earth from it was filled back into the pit, up to the level of its edge, and the balance remaining measured and found to be equal to 191 cubic feet. We have here:—First. An increase from pit to bank of 184 cubic feet; and second, again an increase from bank to pit of 7 cubic feet.

During the rainy season (and the rains in Dharwar are heavy), as the material in the pit sank it was filled up to the level of its edge, and at the end of the rainy season the balance was measured and found to be reduced to 22.5 cubic feet. This showed an increase of the made ground over the pit by 5.3 per cent. The second and third experiments were made in red gravelly soil, or moorum, which is an iron-stone gravel, mixed with about 50 per cent. of earth.

In the second experiment a pit $49\frac{1}{2}' \times 4\frac{1}{4}' \times 2' = 420$ cubic feet, formed a bank which measured $49\frac{1}{2}' \times 6' \times 1\frac{3}{4}' = 520$ cubic feet, giving a first increase of 24 per cent.

A third pit, $49\frac{1}{2}' \times 4\frac{1}{2}' \times 2' = 445$ cubic feet, was excavated, and the material again filled back into pit, leaving a balance of 111 cubic feet = 25 per cent., as a first increase. During the rains the pit was kept filled to level of edge, and after the rains the balance was 55 cubic feet, giving an increase of $12\frac{1}{2}$ per cent.

Although these experiments are on a small scale, still they are of some use as information on a branch of engineering that has not been experimented on as fully as the subject requires. The experiments, however, would be more useful were full information given as to how the embankments were constructed and the pits filled, that is, as to whether wheelbarrows or baskets were used for the carriage of the material, and the earth deposited in layers and rammed; or as to whether the earth was simply thrown out from the pit and thrown back again after measurement in bank.

From the large increase of embankment over the excavation, the inference to be drawn is that the material was not rammed.

Embankments in India are often constructed by basket work, the material being carried in saucer-shaped wicker baskets, containing less than a cubic foot. In the construction of embankments to retain water this basket work is done in thin layers of less than 9 inches in depth, the earth being roughly leveled up as it is deposited from the baskets, and then well punned with wooden or cast-iron rammers weighing about twelve pounds. In addition, the constant trampling of the men, women and children employed in carrying the baskets so consolidates the bank as to make it impervious to water. The layers of earth are sometimes watered. Embankments constructed in this manner shrink or settle very little after they are finished. They are, in fact, an approach to puddle work, though not nearly so expensive.

The writer has constructed embankments with a grading machine, tipping from wagons, from grade, wheelbarrows, hand-cars, carts, scrapers, and punned basket work, and of all these he believes that punned basket work settles the least, and is the best suited for hydraulic work, and the next best work to it for a similar purpose is that done by scrapers.

Thousand of embankments, and some of them counted amongst the largest and oldest dams in the world, have been constructed in India by basket work, without any puddle wall or puddle lining; and some of them, that have been looked after and kept in repair, are as good, if not better, at the present day than when they were originally constructed, hundreds of years since.

This kind of work is done much cheaper there than earthwork in this country. The writer has constructed embankments in the Panjab, the lead being from 100 to 300 feet, for three rupees per thousand cubic feet, that is, at the rate of four cents per cubic yard.

More than forty-five years since Mr. Ellwood Morris, C. E., made some experiments, on a large scale, on the shrinkage of earthwork. The embankments were formed in layers by carts and scrapers, and one winter intervened between the commencement and completion of the work. The results of the measurements are given in the following table:

Nature of Soil.	Excavation. Cubic Yards.	Embankment Cubic Yards.	Compression.	
			In Cubic Yards.	Proportional.
Yellow clayey soil	6,970	6,262	708	0.1015
" "	25,975	23,571	2,404	0.0925
Light sandy soil	10,701	9,317	1,384	0.1293
On the whole	43,646	39,150	4,496	0.1030

The total average compression in embankment being a little more than ten per cent. of the excavation. Other observations, on a smaller scale, showed that gravelly earth shrank about one-twelfth.

The results of these experiments, along with the experiments on rock, are given in the following table.

With a few exceptions, the results of these experiments have been heretofore used, and are still in use to the present day, in American, English and Indian engineering practice.

As a rule, books of reference in the English language give the shrinkage of different materials, without making any allowance on account of different methods of construction and different heights of bank. For instance, the shrinkage of earth in general is given at about 10 per cent. Now, if 10 per cent. be sufficient for the shrinkage of a bank of that material, and 30 feet in height, constructed from the end of bank to the full height by "tipping" from wagons, surely a similar bank only 12 feet high, built up in layers, and consolidated by good scraper work, will shrink much less than 10 per cent.

In no other branch of civil engineering, since the time when railroads were first commenced, has such an immense quantity of work been carried out, and expenditure incurred, as in earthwork; and in no other branch of engineering, of equal importance, have so few experiments, on a scale adequate to the interests involved, been published. In other branches of engineering, long, tedious and expensive experiments are carried out without any other return resulting from them than the information they give; but experiments on earthwork could be carried out on a large scale, as actual work, and with little, if

*Transactions of the Technical Society of the Pacific Coast, read June 5, 1885.

any, additional expense more than the contract price of the work.

In the experiments that have been made there is a want of general agreement, and in some cases the results obtained, in similar materials, differ so much from each other as to point more to errors made by some of the observers than to errors resulting merely from the different methods of construction. This is well illustrated in the table which I now give, showing the percentage of increase or diminution from cut to fill. Some of the materials are mentioned more than once, with a slight change in name, but I deem it better to give the author's own words descriptive of the material than to make a selection of the materials under a fewer number of names.

MATERIAL.	AUTHORITY.	Percentage of Increase + or Diminution — of Embankment to excavation.	Remarks.
Sand	Hewson	— 10	
Very light sand	Graeff	— 10	
Sandy soil	Henz	+ 1 to + 1.5	
Sandy loam	Specht	+ 9	After fill is finished.
Light sandy earth	Morris	— 12.5	
Light sandy soil	Molesworth	— 11	
Gravel and sand	Vose	— 9	
Sand and gravel	Trautwine—Searl	— 8	
Earth	Mississippi Levees—1882		1-5 addition to height of bank.
Earth	Simms	— 10	
Earth (scraper work)	Canadian Pacific R. R.		Shrinkage of bank 10 %.
Earth (grading machine)	Canadian Pacific R. R.		Shrinkage of bank 15 to 17 %
Earth (carefully tamped)	Graeff	— 9 to — 20	
Loam and light sandy earth	Vose	— 12	
Loam	Trautwine—Searl	— 12	
Clay and loam	Von Kaven	+ 2	After fill is finished.
Clay and light soil	Henz	+ 3	
Clay and earth	Vose	— 10	
Yellow clayey earth	Morris	— 10	
Gravelly earth	Morris	— 8.5	
Gravel	Molesworth—Vose	— 8	
Clay	Hewson		1-6 addition to height of bank.
Clay	Trautwine—Searle	— 10	
Marl	Henze	+ 4 to + 5	
Hard clay	Von Kaven	+ 5	After fill is finished.
Hard clay	Henz	+ 6 to + 7	
Clay before subsidence	Molesworth	+ 20	
Clay after subsidence	Molesworth	— 8	
Puddled clay	Trautwine	— 25	
Wet soil	Searles	— 15	
Loose vegetable surface soil	Trautwine	— 15	
Chalk	Molesworth	+ 30	
Soft sandstone	Von Kaven	+ 3	After fill is finished.
Rock	Von Kaven	+ 8 to + 10	After fill is finished.
Rock	Henze	+ 8 to + 12	
Rock	Vose	+ 50	
Rock	Graeff	+ 50 to + 60	
Rock	Rhine Nahe Railroad	+ 25	
Rock	Trautwine	+ 66 to + 75	
Rock, large fragments	Searles	+ 60	
Hard sandstone rock, large fragments	Morris	+ 42	
Blue slate rock, small fragments	Morris	+ 60	
Rock, large blocks	Molesworth	+ 50	
Rock, medium fragments	Searles	+ 70	
Rock, medium unselected	Molesworth	+ 25 to + 30	
Rock, (metal)	Molesworth	+ 20	
Rock, small fragments	Searles	+ 80	
Rock, fragments (loose heap)	Trautwine	+ 90	
Rock, fragments (carelessly piled)	Trautwine	+ 75	
Rock, fragments (carefully piled)	Trautwine	+ 60	
Rock, mixed ½ to ¼ clay	Von Kaven	+ 9	
Rock, with considerable clay	Graeff	0	

The experiments of Henz, Von Kaven and Graeff, given above, are taken from Mr. Specht's paper, already referred to. The experiments of Henz, quoted in the above table, are stated to give the *permanent increase* in volume from cut to fill, and to be the result of a *large number of observations* of actual work.

From an inspection of the table it will be seen that Henz gives a permanent *increase* in volume of from 1 to 6 per cent.—sand and clays—for materials of the same description as those for which Mr. Morris and other engineers allow a *shrinkage* of from 8.5 to 12.5 per cent.

Then, again, for rock Henz allows an increase of from 8 to 12 per cent., and Von Kaven an increase of from 8 to 10 per cent., but for the same material, Morris allows 42 to 60 per cent., Searles 60 per cent., Trautwine 66 to 75 per cent., and Molesworth 50 per cent. of increase.

The writer is at present engaged on the construction of the south jetty of Oakland harbor for the United States Government. In the carefully laid dry masonry of this work, where all badly fitting stones are rejected for face work, and the stones are too large to be laid by hand and require a derrick for that purpose, the voids, before chinking is done, are more than 12 per cent. of the laid face work. There is no method of railroad construction by which an embankment can be made so as to have as few voids as this jetty. On the contrary, however, by the usual methods of construction, the voids will be found to be from six to seven times more than the quantity given by Henz.

The difference in rock between the German and the American and English experiments is very great, but it will not be difficult to prove that there is something wrong with the German rock experiments. Trautwine gives the average weight of granite at 170 pounds to the cubic foot, and he also gives the weight of a cubic foot of roughly scabbled dry rubble granite masonry at 125 pounds. There is, therefore, an increase in volume of 36 per cent. from solid rock to dry masonry. In order to reduce the increase to only 8 per cent. given by Henz, the voids in his rock embankment would have to be less than one-fourth of that of the dry granite masonry mentioned. In railroad construction, as generally carried out, this is not possible. Well dressed granite or limestone uncoursed masonry contains more than 8 per cent. of mortar. General Gilmore, in his work on *Limes, Cements, etc.*, states that ordinary masonry, in *courses* of 12-inch to 20-inch rise, contains about 8 per cent. of mortar.

If the percentage of increase allowed for rock is to be accepted as a fair sample of the accuracy of the experiments of Henz and Von Kaven, as a whole, then the conclusion to be arrived at is, that any estimates based on them must be inaccurate and lead to serious errors.

The disagreement of the German authors from the American and English authors as to shrinkage is certainly remarkable. The Germans give, on the whole, a permanent increase for sands, clays, and similar materials; but, on the contrary, the Americans and English give a diminution. For rock the latter give an increase from cut to fill many times more—in some cases nine times more—than the former.

American and English authorities also differ materially on some points, as shown in the small table below, which gives the percentage of increase for rock of different sizes:

	MOLESWORTH.	SEARLE.	TRAUTWINE.
Rock, large fragments	+ 50	+ 60	+ 66 to + 75
Rock, medium fragments	+ 25 to + 30	+ 70	
Rock, small fragments	+ 20	+ 80	+ 60 to + 90

In this table it will be seen that Molesworth makes the voids to decrease with the decrease in the size of rock, whereas Searle and Trautwine make the voids to increase with the decrease in size of the rock.

Under the heading of *Volume of interstices in Concrete*, Molesworth gives, for five descriptions of small stone, the "percentage of total"—that is the percentage of interstices to total volume. The mean of these five is 44. In a volume of 100, including voids, the voids therefore amount to 44, which is equivalent to an increase in volume of 79 per cent. from the solid rock. This agrees with Searle and Trautwine.

In Gillespie's *Roads and Railroads*, he gives a quotation from Gayffier which says:

"A cubic metre of broken stones, placed in a water-tight box, which they just fill, can receive in the empty spaces between the fragments a volume of water $\frac{48}{100}$, or nearly one-half of the whole, the actual solidity of the stones being therefore only $\frac{52}{100}$. This does not vary for stones from 1 to 8 inches in size."

This is equivalent to an increase of 92 per cent., and is practically a close agreement to the result obtained by Trautwine, with a loose heap of rock fragments, which gave an increase of 90 per cent.

As an instance of large percentage for shrinkage, I may mention the construction of the Western Division of the Canadian Pacific Railway, where 10 per cent. was allowed for the subsidence of earthen embankments constructed by scraper work, and 15 to 17 per cent. for similar banks constructed with a grading machine.

Another instance of still larger percentage is that on the construction of the levees of the Mississippi (1882), where 17 per cent. is allowed for shrinkage of *embankment*, and this, be it remembered, is for an embankment which is intended to keep out water. The specifications do not state the method of construction, and no mention is made of a grading machine, but it is stated that, "a sufficient number of dumping men be kept on the levee to spread the earth as it is wheeled or carted in."

In sandy loam Mr. Specht found the volume of embankment, after completion, to increase more than 9 per cent. over the excavation. Morris and other authorities found that similar materials had an ultimate shrinkage of over 10 per cent. Therefore to cause an equal shrinkage of 10 per cent. from cut to fill in Mr. Specht's work, his *embankment*, after completion, would have to shrink about 18 per cent. In other words, a bank of loam 10 feet high, built up in layers, by scraper work, would have to settle about 2 feet.

An examination of the table will show other serious differences between the authorities given, in the percentage allowed for shrinkage.

In such experiments any near agreement is not to be expected, but at least it is reasonable to expect a general agreement tending one way from the same materials in similar banks. The experiments conducted in this manner should all show, for similar materials, either a diminution or increase, and not a diminution in one case and an increase in the other.

[TO BE CONTINUED.]

Piping for Natural Gas.

The fire marshal of Pittsburg, Pennsylvania, has, at the instance of the board of fire underwriters, issued the following rules for gas-fitters, to be followed when laying on natural gas:

"All pipes must be tested by the gas company's inspector with mercury column to ten pounds pressure, from end of line where connection is made to end of pipes under grates, stoves, etc.

The fitter should have his pump on and see that the pipes are perfectly tight before sending for the inspector.

The ends of pipes under grates, stoves, etc., should first be capped, so as to allow the stop-cocks to be tested; then remove the caps and see if the cocks allow the gas to leak.

In case the mercury drops, a test for leak by putting ether in the pump, or with soap water will be made.

In no case shall a fire test be used in dwellings, offices, stores, etc. No cement of any kind shall be used for repairing faulty fittings or work; nor is the use of blind gaskets permissible.

When any attempt to hide leaks is made, the name of the fitter will be kept on record in this office, and future work done by him will not be approved without rigid examination.

In running pipes in buildings no set rules can be given, except that pipes must, in all cases when possible, be so placed that they can be easily inspected; and that in case of accident any leaking gas may escape easily.

"Cement wall carefully where service pipe enters the building, and use a large pipe for the main that runs through the cellar. Provide valves to shut off gas from all risers. In running pipes through flues great care is necessary, and lead pipe for the bends should not be used.

"Do not run between floors or walls when any other method can be employed. Do not place cocks between floors or ceilings. Do not use any valves which require packing at the stem in places where leaking gas may be dangerous. If pipes run outside of walls, provide a drip.

"Allow plenty of air under grates, so that the hearthstone may not get too hot. Set the back tile in the grate so that the unburnt gases will be directed up the chimney, and not allowed to enter the room.

"By admitting more air under the grate, so that it will percolate through or between the hot bars in grate, results in a cheerful, bright fire from bottom of grate to the top of the fittings, and also in front.

"In fitting up a building, all gas-fitters will be required to furnish the gas company, who are to supply the fuel, with a statement giving the number of fires fitted up, and also any additional fires that may be connected afterward in the same building, so that a complete record may be had at this office. Blank forms for this purpose will be furnished by the different companies supplying natural gas.

"It should be borne in mind that a leak of natural gas is not so perceptible as of artificial gas, on account of the very slight odor arising from it; and more care should be taken in piping a building for its use.

"Fitters should also remember that accidents and explosions are likely to occur through defects in fittings and pipes; and as the introduction of natural gas is a benefit to the fitters, the community at large, and to the insurance companies, the fitters should do all in their power to make the use of natural gas as safe as possible; and they can materially aid in this by endeavoring to put in pipes and fittings in a perfect manner."

The Sphinx.

An appeal has been made by M. Ernest Renan for funds to enable M. Maspero to remove the sand from around the Great Sphinx. The work, he says, is valuable, and will enable us to descend into a world that is more than six thousand years old, and will push further back the limits of a past age that seems to become more remote as we try to reach it.

"The clearing of the Great Sphinx," says M. Renan, "was begun two months ago. Up to the present time the ordinary resources of the Boulak Museum have sufficed for the work, which might be completed in sixty days if money did not fail. About twenty thousand francs only are wanted. The appeal for the Longson excavations, which was addressed two years ago to the intellectual public, was so fruitful that we are encouraged once more to ask the true connoisseurs in ancient things to contribute to one of the works, the most imperiously demanded by the present condition of Egyptology. The Great Sphinx of Ghizeh, at two steps from the Pyramids, is, in my opinion, the most astonishing work of the hand of man which past ages have bequeathed to us. It is an immense bed of carved rock, about 70 metres in length. The height of the monstrous edifice, if it were cleared, would exceed that of the highest houses. No fashioned monument, either in the rest of Egypt or in the rest of the world, can be compared to this strange idol, the vestige of a stage of humanity which baffles all our ideas. The impression which such a spectacle must have produced on imaginative races, and who were dominated by the senses, may be understood from that experienced by the Egyptians of the present day when standing before that enormous head emerging from the sand and casting across the desert its sad look. The Arab at this sight flies terrified, either throwing a stone or firing a gun at the strange being. The temple opposite the Sphinx, if it is a temple, has also a character of its own. This fantastic construction resembles less the other temples of Egypt than the Pantheon resembles Notre Dame. But that all this ensemble, which is unique in the world, must be of the remotest antiquity is indisputable, since the statues found there are those of King Chepren, thus taking us back to ages which everywhere but in Egypt would be called fabulous."

NEW YORK ALDERMEN.—For the first time in the history of the city, the people have got one board of aldermen grouped and classified according to the simple evidences of its record, and so that nobody can misunderstand what sort of persons they are. There were twenty-four aldermen in the board of 1884. Of these, fifteen have been arrested, charged with crime; one is in custody as an informer; three are fugitives from justice; two are dead; one is still at large for undefined reasons, and two are known to be honest. The proportion of men known to be honest is shockingly small, and the record is not flattering as to popular institutions. But the thinker who wishes to derive from the case all the instruction it can afford must not neglect the peculiarities in the names.—N. Y. *Evening Mail.*

The Deerfield Accident.

Below we give the testimony of Civil Engineer E. K. Turner of the Fitchburg Railroad and Manager A. W. Locke of the State road, before the railroad commissioners at Boston, Monday, April 13th:

Mr. Turner said that he never had his attention called to the spot until the accident took place. He had been over the road several times with a view of seeing its condition. He never had occasion to form an opinion about that particular point. He had every reason to believe that the whole of the State's road was safe. Until after the accident he had not examined the road after the second track was put in. He never saw much water in the ditch there. Before the second track was put in, he had occasion to go over the road, and considered it safe and well constructed. He did not think the second track had anything to do with making it unsafe. From an examination since the accident he judged that the ditch might have been filled up some.

Mr. Locke testified that he had been general manager of the road since 1881. He reached the scene of the accident about 7 o'clock. The locomotive lay on its right side 160 feet from where the cars appeared to have left the track. The witness then produced a plan showing the scene of the accident, and the position of the engine and cars when he arrived there. Continuing, he said that the horizontal distance from the track to the river is 101 feet, the perpendicular distance 100 feet, and by the slope 135 feet. He judged from appearances that the bank slumped down. The track seemed to have moved out two feet and a half. There were 48 in all on the train; three were not injured at all, 10 have died from their injuries, and all the rest were more or less injured. The roadbed was 31 feet wide, seven feet being between the outside rail and the edge of the slope. The roadbed has not been changed since the road was built in 1864. The outer track was not moved when the second track was built.

The second track was put in use in September, 1884, and was laid by digging out on the side of the ledge. The roadbed was thus widened 12 feet, and what ma-material came out was cast over on the outside. No indication of weakness on the outer track ever came to his knowledge. He has examined it a hundred times, and there was no weakness. The embankment was constructed entirely of rock. Herman Haupt was the contractor of the whole work, but he did not know who did that particular part. From the facts it appeared to him that the bank had gone down and left the track; what caused the bank to move he did not know. The ditches were 20 inches deep. The water flows west in the ditch, and when there is a sufficient amount of it it escapes through a culvert. All the water flowing there at the time of the accident could run through an inch and a half pipe. He did not think it rained that day. It snowed a little at the time of the accident.—Fitchburg *Sentinel.*

The following explanation of the cause of the accident was given by one who is well qualified to form an opinion:

"An unusally large amount of rain has fallen during the winter and the embankment was thoroughly saturated with water. You have probably observed, when a boy you played building dams, that when the dam became saturated the least jar would cause it to give way. The railroad embankment was probably in a similar condition and the jar of the train caused the embankment to settle, the finer material going down among the stones and coarser material."

Railway Building in Colorado.—There is an excellent prospect that there will be a large increase in the railway mileage of Colorado during this year. The Colorado Midland R. R. has already let the contract for the construction of a standard gauge road from Leadville across the range to the mouth of Frying Pan. It is rumored that the Denver & Rio Grande R. R. will be taken out of the hands of the Receiver, and that upon the reorganization of the company the extension of its Red Cliff line will be begun. It is not unlikely that the Burlington will begin work upon a line to be run from Denver through Middle Park toward the western border of the State. Work will be begun within a month upon the extension of the Denver & New Orleans, or, as it is now called, the Denver, Texas & Gulf R. R., and it is expected that at the Canadian river a connection will be made with the Fort Worth & Denver R. R. The length of the road to be built is a little less than 300 miles, but the projectors think they can build this before the close of the year. Much of the route presents no obstacles worth mentioning to the construction of the road, and the track can therefore be laid very rapidly.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.
TRIBUNE BUILDING, - NEW YORK CITY.

THE ENGINEERING NEWS PUBLISHING CO. PROPRIETOR.

VOL. XV. Saturday, May 1, 1886.

CONDUCTED BY
GEO. H. FROST, - - - Assoc. Am. Soc. C. E.
D. McN. STAUFFER M.Am.Soc.C.E.: M.Inst.C.E.

TERMS OF SUBSCRIPTION.
TO U. S. AND CANADA.

One Year	$5.00
Six Months	2.50
Three Months	1.50
Single Copies	12 cts.

OTHER COUNTRIES.
Add Postage 3 cents for each number.

TABLE OF CONTENTS.

	PAGE
A new Method of Sewer Building (*Illustrated*)	273
Sea Coast Fortification in Holland	274
Municipal Engineering (*Illustrated*)	274
Good Roads	276
Shrinkage of Earthwork	277
Piping for Natural Gas	279
The Sphinx	279
The Deerfield Accident	279
Editorial Notes	280
The Present and Future of the Panama Canal	280
Civil Engineer Fees	281
Railroad Regulations in Germany	281
The Waterways of Northern Illinois (*Illustrated*)	281
Testing Cement	283
Personals	266
Engineers Club of Philadelphia	285
Liverpool Engineering Society	285
Water	285
News of the Week	286
Market Report	288
Trade Notes	288

WE wish to buy all the copies of ENGINEERING NEWS of March 27th and April 3rd, 1886, that are offered, and will pay 12 cents in cash, or send the "Engineers' Field Book" for each copy received.

A CONVENTION of Highway Commissioners was held at Springfield, Ill., on Tuesday and Wednesday of this week, under the auspices of the State Board of Agriculture. Several papers on the subject of roads generally are down on the programme and at as early a date as possible we hope to publish for the benefit of our readers some of their contents.

A NEW crime has been added to the list of indictable offenses—boycotting—which has been taken notice of officially by the Grand Jury of this city this week, who returned thirty-four cases for trial on Tuesday. It is conspiracy to injure a man's business, and is punishable by fine and imprisonment.

DETAILS of the bids for the construction of the Harlem River Bridge cannot be obtained, as it is not intended to make them public. The reason given is that the details were required only to prevent the sending in of unbalanced bids, and are to be considered as the private notes of the contractors; the gross amounts alone will be considered in awarding the contracts. There is no foundation for the rumor that the awards have been decided upon.

AT Albany on the 27th the bill introduced by Representative Bruns to consolidate the bureaus of the Public Works Department of this city failed to obtain the two-thirds vote necessary to its success. Mr. Hamilton introduced a bill constituting the Mayor, Controller, President of the Department of Public Parks, the Commissioner of Public Works, and the President of the Board of Alderman a Board of Street Pavements of New York, with exclusive control in the matter of paving and repaving streets and avenues, the amount to be expended annually not to exceed $600,000, nor fall below $300,000.

AT a meeting of the Southern Society of Civil Engineers held at Jacksonville, Fla., April 19th, Wm. Page Couper, Chief Engineer of the Florida Southern R. R., Bartow, Fla., was elected member. A section of a self reading level was presented to the society, with a description, by the inventor, Mr. M. L. Lynch, Chief Engineer of the Gulf, Colorado and Santa Fe Railroad, Coleman, Texas, after which H. S. Duval, President of the Society read a paper on the "Hydraulics of the Okeechobee Region of Florida."

ACCORDING to published statements, the Chicago, Rock Island and Pacific R. R. Company are on the eve of extensions and developments of their road far beyond those of any other single company in the country. Seven hundred miles of new road are to be built west of the Missouri river the details of which are promised by the end of next week.

One of the reasons prompting the undertaking at this time is the favorable state of the market regarding materials used in railway construction. A new road can be built more cheaply now than for a long time past.

Ten millions of bonds have been issued to meet the expense of the new work.

THE Bulletin of the Iron and Steel Association gives the following items of production: For the month of March, the Edgar Thompson Steel Works made 20,875 gross tons of steel ingots, and the Pennsylvania Steel Works 20,863 gross tons; and during the same month the Pittsburg Steel Casting Company, in 270 hours with one converter, made 2,902 gross tons into refined Bessemer for special purposes, the range of carbons being from .07 to .70. On the 2d ult., the North Chicago rolling mill, in nineteen hours and twenty-five minutes working time, rolled 2,818 60-pound rails, yielding 746 gross tons. It would only take five such concerns as the North Chicago mill to supply the country with rails, and four like the Edgar Thompson to supply the steel.

THE London financial papers are publishing the prospectus of the Delagoa Bay & Transvaal Railway Company (Limited) asking for subscriptions to 6 per cent. bonds that are apparently to be issued at the rate of $40,000 per mile on 52 miles of railroad to be built from Delagoa Bay towards the Transvaal under authorization of the King of Portugal. As the money for this line is to be raised in London, the engineering, constructing and stocking of course goes to England, though as it is to be a narrow gauge road, unless it is better managed than the South African road that had its traffic taken from it by bullock carts, it will not be a very profitable undertaking.

The great difficulty with the enterprise is the extremely unhealthy character of the country for the first 20 or 30 miles west of Delagoa Bay.

FROM a facsimile of the Philadelphia *Ledger* of 50 years since, we find that beet sugar was then first shown in that market, the editor saying "we confidently believe that this sugar will soon become in great demand." Neville Lubbock, in an address reported by *Colonies & India*, before the Colonial Institute gives the following figures: In 1860-61 the production of cane sugar was 1,496,264, and beet root sugar 336,826, tons in 1884-85 the amounts were 2,148,000 for cane, and 2,500,000 tons for beet root sugar.

The entire beet sugar industry has grown up with the last 70 years and its rapid increase, which has almost ruined the West Indies, is due greatly to bounties from the Governments of France, Belgium, Germany, etc. It is claimed by those interested in cane sugar that this has not benefited the countries above named, but sugar is one third the price of 50 years ago and the farmer growing sugar beets will increase the amount of wheat raised and cattle carried on his farm.

THE Chicago *Times* notes that "The city of Berlin with about the same population as New York, has 300,000 more square yards of streets than the American metropolis. It has comprehensive educational and charitable systems, and maintains twenty-three circulating libraries. Its annual municipal expenditures are under $10,000,000. The annual expenditures of New York are nearly $36,000,000—over $10,000,000 being required for salaries of officeholders alone."

THE lease of the Utica and Black River R. R. by the Rome, Watertown and Ogdensburg R. R. Co., which occurred April 14th, is one of the most important transactions in railway circles, of recent date. The latter company becomes one of the large and important railway corporations of the country; it now controls 607.4 miles under its single management and is negotiating to add to this the 118 miles of the Ogdensburg and Lake Champlain R. R., making a total of 725.4 miles under the single management which thus gains control of all the traffic of northern New York, west of the Delaware and Hudson Canal Co.'s line in Lake Champlain. The two lines recently brought under one control were built as competitors for the trade of Watertown, Oswego the Thousand Island summer travel, and the trade of the Canadian Pacific R. R. Co. The Utica and Black River R. R. is the most direct line from New York to the regions traversed by the Canadian Pacific R. R., and it is in a prosperous condition. Competitive rates some time ago gave place to pooled rates, but now there is no reason why the combined line should not pay well, as it has absolute undisputed possession of the field. With the acquisition of the Ogdensburg and Lake Champlain R. R. it will have a through line from Suspension Bridge to Rouses Point, and thence through to New England points. It may, therefore, be considered another trunk line.

The Present and Future of the Panama Canal.

The New York *Tribune* of the 24th gives in substance the following interview with Captain W. B. Sherwood, who for seven months has had charge of one of the American dredges excavating the canal, who says that through the system of sub-contracting in vogue their responsibility is so poorly defined, that it is impossible to remedy the numerous evils which exist in the working of the various departments.

The French officers, who lack energy and executive ability, have not sufficient stamina to get efficient service out of the Jamaica and Martinique negroes who are, as a rule, of poor physique and lazy, 100 of them not doing as

much work as six American laborers, according to the Captain, who does not believe that the canal can ever be opened under the present management, which he characterizes as of reckless expediture coupled with lack of discipline, and general dilatoriness.

Advices from residents on the Isthmus are to the effect that a general break up is expected, the purchasing department being charged with such outlays as $1,700 for steel pens, and 600 claw bars, which for a road fifty miles long is rather liberal.

The growing necessities of commerce will doubtless lead to the construction of a canal at Panama, but it will not be a sea level canal in the face of the Chagres river and the Culebra cut. Something very like the plan proposed by Mr. C. D. Ward, during the discussion before the American Society of Civil Engineers in 1880, will probably be adopted. That was to dam the Chagres at the level of the cut through the summit, constructing a weir on the dam so long that floods in the river would make but little difference in the height of water in a proposed pool, ten miles in length, and that height he proposed to control by guard gates.

This plan is superior to Commander Lull's, in that it does away with the aqueduct and long feeder proposed by him, while by keeping on top of the Chagres and being less expensive than the plans of de Lesseps, and at the same time nearly as available as a sea level canal, it is preferable to the present plan.

Civil Engineers' Fees.

"As I am a stranger in the land and am quite isolated from any brother engineers, I would deem it a favor if you would kindly tell me the usual fees charged by civil engineers in this country for professional field work and advice, and superintendence of works in construction, etc.

By experience I know charges vary greatly in different countries in accordance with the demand and the supply to meet it. I shall be called upon to present my little bill for work done in surveying and levelling for a land company here, and though I do not wish to cheapen my services I cannot afford, with the view of procuring future work if I should have to remain here, to open my mouth too wide."

Our correspondent is an Englishman, and is engaged on his first important work of surveying and engineering in his new home in a southern state. Accustomed to prices of similar professional services in England he will undoubtedly feel at a loss what price to charge on this side the Atlantic. Judging from what we have read and heard about the prices paid for engineering services in England, we are led to infer that they are very much more liberal than those of America, for which condition of things we congratulate our professional brethren of that favored country. It must be remembered, however, that the practice of civil engineering in England is held mainly by a comparatively few men prominent in the profession, who are paid very large incomes and by whom the younger men and those who are unable by their own efforts to command an independent clientale, are employed on generally small salaries. In the United States the practice of surveying is usually pursued by individual surveyors, who, in the cities and towns employ at low salaries one or more assistants. The yearly income of surveyors ranges from $300 to $3,000, and he is a fortunate man who is paid the latter.

In 1873 we published in ENGINEERING NEWS a list of salaries of City Engineers in the principal cities of the country: Albany then paid $8,000; Providence, $2,750, other cities paid from $4.00 to $10.00 per day, assistants extra; Middletown, Conn., paid 70 cents per hour for time employed; Syracuse paid $1,200, was allowed one assistant, and was not allowed to do outside work. The pay in the smaller cities was usually $1,200 to $2,000. We do not know what the salaries of City Engineers and Surveyors in the United States are now, but if they are the same as in 1873, the purchasing power is nearly double.

In Connecticut County Surveyors used to be pain $1.50 per day, and in Vermont and New Hampshire the same wretched stipend was accepted. In Chicago the rate per day has been $10.00 and expenses, but work was mostly done by previous engagement for a lump sum, the surveyor taking the chances. This was for ordinary land surveying; for more particular work $15.00 to $25.00 was charged and paid. For the last large survey we made, occupying twenty-six days on a tract entirely wooded, cut in all directions with deep and wide ravines, remote from a boarding place, and which was to be carefully mapped for the landscape engineer's subsequent use, we charged $15.00 per day and expenses, and in a suit before a jury the whole claim was allowed. The highest salary lately quoted is being paid to Rudolph Hering, Sanitary Engineer, by the City of Chicago, for special services relating to the sewerage and water supply of that city; the amount is $10,000 per year and is exceptional, although we hail it as the indication of higher rates of payment for future special engineering services, somewhat commensurate with the importance of the vast interests upon which civil engineers are called to pass judgment and to estimate for. The profession is being rapidly divided into special departments, and the engineers who are contented to devote time, talents and study to special subjects, are pretty certain to win in the long run. Every individual engineer or surveyor should feel like our correspondent "no wish to cheapen his services," but everywhere and at all times should endeavor to magnify his profession until it will seem as necessary to infer a "retaining fee" in consulting an engineer as it now does a lawyer or a doctor when one asks for a "bit of information." Young engineers climb the ladder of success to a certain height, more rapidly than doctors or lawyers. There they stop—sometimes for the rest of their lives, but not always—while the others, after years of weary drudgery and waiting are carried on the wave of fortune to heights where engineers are rarely seen. How then are the civil engineers of America to get over the "dead center" of mediocre incomes, and like their brethren of world-wide celebrity in England, more of them become the recipients of like princely incomes and equally wide reputation for great professional achievements?

Railroad Regulations in Germany.

Of the 22,210 miles of railroad in Germany, 1883-4, only 3,178 miles were in private hands, the rest belonged to, or were worked by, the Prussian or other State Governments. The administration of the state roads lies in the Minister of Public Works, advised by a council, consisting of forty-one members, all holding office for three years. Since the 1st of April new regulations have been enforced, one of which seems in opposition to our practice, viz.: the maximum load of engines in mixed trains is reduced from 120 to 110 axles, the axle being the German train unit, instead of the car as with us. Others, as limiting the speed of engines when behind time, and requiring the lighting of cars when passing through tunnels that require two minutes instead of four as before will be generally approved, while distinctly recording on each engine the greatest speed at which it can be run with safety, and which is, under no circumstance to be exceeded, must make the life of the driver of the slow engine burdensome, at least while about the round house.

The Waterways of Northern Illinois.

We are indebted to the Chicago *Morning News* of the 7th inst. for the accompanying profile and map, with a very careful study and clear presentation of the environments of the Illinois and Michigan Canal and the proposed Hennepin Canal, evidently from the pen of a civil engineer.

After a short skirmish with the topography about Chicago and the early history of the canal, the writer asks, "What has Illinois done?" The immediate answer is, "She has expended the proceeds of a canal grant on a one-horse canal ninety-six miles long." The whole history of the improvements of the waterway from Chicago southwards is, according to the writer, a record of blundering obstructive engineering, and the proposed Hennepin Canal as it is now laid out, is no less obstructive to, and inadequate for, the commerce of the country, faults that are laid more to the incapacity of "statesmen" than to that of engineers.

The *great* blunder was the failure to slack water the Illinois to Joliet, so that nearly forty years ago steamboats might have come within thirty-five miles of Chicago, instead of continuing the canal to La Salle, as in that case Chicago would have had steamboat connection with the lower river long before this. The excuse that slack-watering rivers was not then understood is shown to be untenable, by the citation of the following facts: The land grant in aid of the canal was passed in 1827, two years after the completion of the Erie; and the canal was finished in 1848, ten years after the commencement of the enlargement of the Erie. Before and about this time the following rivers were slackwatered: The Green and Kentucky rivers, 1833-41; locks, 160 × 36 and 170 × 38. The Muskingum river, 1837-41, locks, 180 × 36. The Monongahela, 1836-42; locks, 190 × 50. The Fox river, 1848; locks, 125 × 30—enlarged in 1856 to 165 × 35. To which should have been added the slack-watering of the Lehigh, 1821, to, 29 by Josiah and Canvass White who built the first movable dams that were ever permanently employed to aid navigation.

Very decided objections are taken to General Wilson's report against a through cut and feeding the Illinois from the inexhaustible reservoir of Lake Michigan. See Report of Chief of Engineers 1888, p. 441, et seq. By comparing the map and profile, it will be seen that Bridgeport, the commencement of the canal, is about 5¼ miles from the mouth of the Chicago river; from that point to Summit is 8 miles and to Lockport 29. At Summit the canal enters the valley of the Des Plaines, the surface of which is 8 or 9 feet above the Lake. From Bridgeport to about a mile beyond the entrance of the Calumet feeder, at Sag Bridge, or for 18½ miles the excavation is clay, sand and hardpan; from there to Lockport the excavation will be in limestone, which is found in horizontal beds and is known in Chicago, when it is used for building, as Lemont stone. The Des Plaines river in its low water flow only carries 33 cubic feet per second, though in flood, as the Des Plaines drains about 1,000 square miles, it must be much more. After reciting the above conditions the General says that a supply of 4,555 cubic feet per second would render all but two of the proposed dams below La Salle unnecessary and deciding on a depth of 8 feet he assumes the three following channels:

Channel	Width	Fall per mile	Velocity miles per hour.
1st.	160 feet	1.11	2.43
2d.	200 "	0 69	1.93
3d.	350 "	0.23	1.104

(All only 8 feet deep).

Adding "It would appear then, to obtain the requisite supply of water from the lake without excavating a wider channel than we have recommended, that it would have to be about 30 feet deeper opposite to the present lock No. 1, than at present, or 10 feet deeper than the bed of the Des Plaines river opposite the town of Lockport," adding that the increased flow in comparison with locks would be of doubtful advantage as the consequent current would give boats now in use on the river, a more rapid current to stem.

If the General had assumed a depth of 15½ feet, still retaining his width of 160 feet and fall of 0.14 per mile or 4.06 for the whole distance, he would have gained a superior elevation of 28,13 feet over his 1.11 grade and, would have had with a velocity of 2.83 miles per hour a discharge of 4712 cubic feet per second, supposing the channel to be rectangular, the excavation saved on the mile ending opposite to lock No. 1, would amount to over 650,000 cubic yards, and there seems no reason why the bed of the Des Plaines would not be the most economical location.

Objections may be taken to the width (160 feet) decided on, as the locks so far built at the dams below La Salle are 75 feet wide, and it has been found necessary to enlarge the Suez canal to a width of 196.6 feet on the bottom, for ships 60 feet wide, or about 3¼ times the width of the vessels using it. This would give a width of 250 feet for the canal, and with a depth of 15 feet a discharge of 7,500 cubic feet per second, and a velocity of 3 miles per hour, The incidental advantages of this plan in addition to this speed and safety of navigation would be the saving of further expense on locks and dams in Illinois, the entire change of the water in the Chicago river several times per day and available water power of about 64,000 horse power, which at the capitalized value of a horse power assigned by Mr. Emery at the St. Paul meeting of the American Society of Civil Engineers, viz: $660, would add over $42,000,000 to the value of our country.

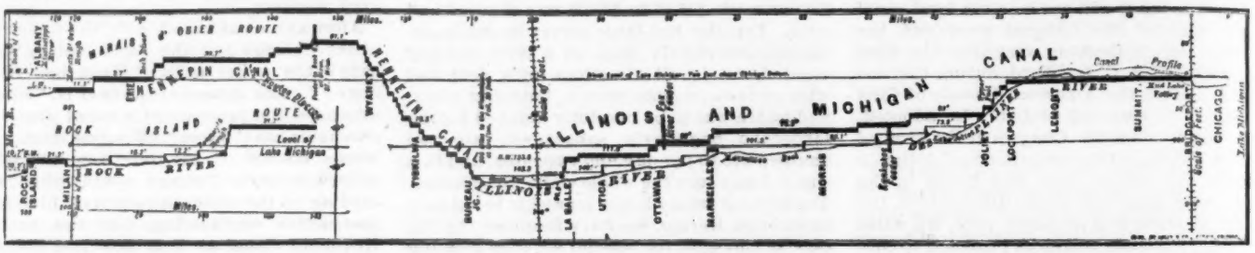
There can be but small doubt that with the combined commerce of the Illinois river and that of the Hennepin Canal, if its size is made sufficient to accommodate the boats now in use, the width of 250 feet would soon be fully occupied.

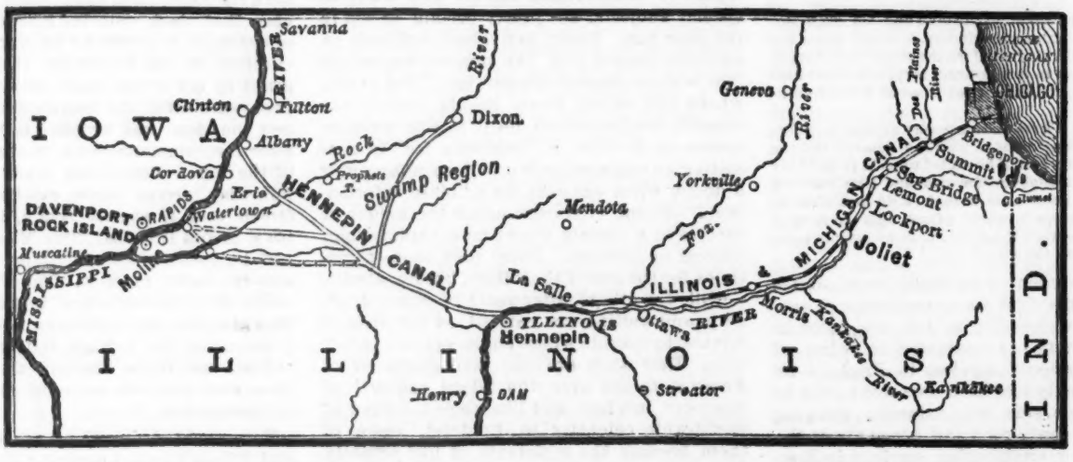
In the history of the Hennepin Canal project, we find, after mention of the survey by Hudnutt in 1866, and its revision under Gen. Wilson and Col. Macomb, that "although the lake and Mississippi river are nearly at the same level, 421 feet of lockage in 173 miles is required to reach the Marais d'Osier terminus, and 448 feet in 186 miles for the Rock Island terminus. This lockage will add not less than a third to the length of the route, so far as time in transitu is concerned."

An attempt was also made to find a route direct from Chicago to Fulton on the Mississippi, so as to avoid the heavy lockage of the Illinois valley route. A line was run northwest in the vicinity of the Chicago & Pacific railway until a summit of 250 feet above the lake was attained and the survey abandoned. This led to the conclusion that the route via "the Hennepin Canal and upper Illinois river and enlarged canal from Joliet to Chicago will afford the best through route for navigation * * * that can be secured in this vicinity." It must be said, however, that none of these early surveys were more than preliminaries, and that also the best probable route north of the Illinois valley has not been examined.

As of interest in this connection it may be mentioned that Rock river, through Lake Horicon to Lake Winnebago, thence to Green bay, was surveyed under Gen. Wilson in 1866 and found feasible for an admirable waterway. The locks adopted were 200 × 30 feet. A portion of this stream is utilized in the Hennepin project."

Now there is probably no transitman in the land that after an inspection of the above map and profile would not undertake to locate a lake level canal as far as Wyannet, and thus save about 280 feet of lockage. Whether it would be as easy to turn the ridge on which the Rock river feeder enters the present location is not so apparent, but the advantages which a level canal throughout would offer to commerce are so great that the problem is worth a great deal of study. Notice is taken of the legislation, both National and State, by which the route of the canal is fixed, viz.: via Hennepin, and the locks are specified as not less than 150 × 21. As noticed in our issue of March 13th, these dimensions have been fixed at 170 × 30, and our Chicago namesake agrees with the objections there made, urging that in practice the effect would be that all cargo in large vessels coming from the Mississippi would be compelled to break bulk and transship at or near Rock Island. Though the absurd plan of governing the depth of the canal by the present "minimum draft of the boats at the most unfavorable stage of the main river," and thus affording a ready argument against further improvements tending to cheapen the cost of transportation, is not characterized as it deserves, yet its inadequate size is shown, as its proposed cross-section is only 485 square feet or 25 per cent greater than the old Illinois and Michigan canal, while the proposed boats will be twice the section of the old canal boats, also that its section is but ten per cent. greater than that of the Erie canal, while the boats have seventy per cent. greater section.





Representative Murphy's bill (referred to in our issue of the 13th ult.) locating the western terminus below the Rock Island Rapids and proposing to construct the Hennepin canal on the narrow gauge plan, before completing the enlargement of the Illinois and Michigan canal is assailed and the arguments of the Chief of Engineers, who, he says, argues the merits of the Rock Island line better than Mr. Murphy himself are treated as follows:

"He shows that it is easier to get down the rapids than to get up, and that Rock Island and Davenport are great railway centers which will furnish traffic to the canal from a large district. The chief must be a novice in railway transportation or he would know that the railways pass through or intersect at these towns but do not stop, and it will be a small matter to so adjust through and local rates that not a carload will ever stop or transshipment to boats. He should also under-

stand that the cost of the trans-shipment would pay a good portion of the haul to Chicago when once on board cars. The argument would apply as well to the Marais d'Osier line, with Clinton, Fulton, and Lyons near its terminus.

As a matter of fact, the route will serve the many cities and towns along the river, pick up a coasting trade from the tributary country, build up a large commerce with St. Paul and Minneapolis, really the only important market points of the northwest, reduce by a large amount all freight rates to Mississippi points, and indirectly benefit rates to intermediate points and beyond throughout a large district."

Notwithstanding General Newton's great experience with such matters we think that by far the larger part of the traffic to be expected from the canal will come from above the rapids rather than from below, as Minneapolis and St. Paul combined bid fair to be, after Chicago, the largest manufacturing and distributing points in the northwest. As the coal supply of all that country will be drawn from the southeast, it is not improbable that the ascending freights on the Mississippi will counterbalance the descending freights.

The writer in the *Morning News* has treated the subject with accurate knowledge and great breadth of view, thoroughly establishing his proposition that the present scheme does not cover the proper route, does not provide an adequate channel, and that until more thorough examinations for the most feasible route in distinction from the route deemed best on legislative grounds, the time for the construction of the Hennepin canal has not yet arrived.

Testing Cement.

Although much has been written and published concerning this important feature of engineering construction, the facts coming to our knowledge are such as to convince us that many do not understand the fundamental principles involved. Therefore we have had prepared the following simple statement of these principles, and offer it to such as have not already become experts in this line:

The properties of a cement which are usually examined to determine its constructive value are: 1, color; 2, weight; 3, activity; 4, soundness; 5, fineness; 6, strength. The last three are the most important.

Color.—The absolute color of a natural cement indicates little, since it varies so much in this particular. But for any given kind variations in shade may indicate difference in the character of the rock or in the degree of burning. The higher the degree of heat in burning, the better. With Portland cement gray or greenish gray is generally considered best; bluish gray indicates a probable excess of lime and brown an excess of clay; an undue portion of under-burned material is generally indicated by a yellowish shade with a marked difference between the color of the hard-burned, unground particles, retained by a fine sieve, and the finer cement which passed through the sieve.

American cements are generally brown, in light or dark shades. With Rosendale a light color generally indicates an inferior under-burned rock.

Weight.—For any particular cement the weight varies with the degree of heat in burning, the degree of fineness in grinding, and the density of packing. Other things being the same, the harder burnt varieties are the heavier. The finer a cement is ground the more bulky it becomes, and consequently the less it weighs.

The weight per unit of volume is usually determined by sifting the cement into a measure as lightly as possible, and striking the top level with a straight edge. In careful work the height of fall is specified. For a method of still greater refinement, see Trans. Am. Soc. of C. E. Vol. 13, p. 55. Since the cement absorbs moisture, the samples must be taken from the interior of the package. The weight per cubic foot is neither exactly constant, nor can it be determined precisely, and, for the practical purposes of the user, is of very little service in determining the value of a cement. However, it is often specified as one of the requirements to be fulfilled.

The following values determined by sifting the cement with a fall of three feet into a box containing one-tenth of a cubic foot, may be taken as fair averages for ordinary cements. The difference in weight for any particular kind being mainly due to a difference in fineness:

Portland, English and German	77 to 90	lbs.	per cubic ft.
" fine ground French	69	"	"
" American	95	"	"
Roman	49 56	"	"
Lime of Tiel	50	"	"

The weight per bushel is sometimes given: as a bushel is very nearly 1¼ cubic feet, the weight per bushel can be obtained sufficiently close by adding 25% to the above quantities.

Activity.—A mortar is said to have set when it has attained such a degree of induration, that its form can not be altered without causing a fracture; that is when it has entirely lost its plasticity. Some cements are remarkably quick in exhibiting their hydraulic property; others are comparatively slow in developing the first indications of hydraulicity. This property is called hydraulic quickness or activity. A quick setting cement is especially valuable in constructions under water or in positions subjected to immediate submersion.

A distinction should carefully be made between hydraulic activity and hydraulic energy or strength; the former refers to the time required to attain a small degree of strength, and the latter to the amount of strength ultimately attained. There is necessarily no relation between time of setting and ultimate strength, however, as a general rule, the slow setting cements ultimately attain to a greater strength than quick setting ones.

"The effects of a variation of temperature, upon the hydraulic quickness of mortars, whether derived from hydraulic lime, hydraulic cement, a mixture of common lime and puzzuolana, or produced by artificial means, is very marked; so much so indeed, that in all the comparative tests of this kind, it is important to adopt some fixed standard of temperature, not only for the water with which the cement is mixed, as well as that in which the cement is immersed, but for the dry ingredients and the surrounding atmosphere. All cements are not equally sensitive to a variation of temperature."

The activity of cement may be increased by adding a quicker setting cement, plaster of Paris, lime, clay or even grease. All such ingredients, particularly the last, weaken the resulting mortar.

To test hydraulic activity, mix cement with twenty to twenty-five per cent. of its weight of clean water, having a temperature of between 65° Fahr. and 70° Fahr., to the consistency of a stiff plastic mortar, and make two cakes, or pats, 2 or three inches in diameter, about ½ inch thick. As soon as these cakes are prepared, one of them is immersed in water at 65° Fahr., and the time noted that these cakes take to set hard enough to bear respectively a $\frac{1}{12}$-inch wire, loaded to weight ¼ pound, and a $\frac{1}{24}$-inch wire, loaded to weigh 1 pound. When the cement bears the light wire, it is said to have begun to set; when it bears the heavy point, it is said to have entirely set. However, cements will increase in hardness long after they will just bear the heavy wire.

Different kinds and brands of cement vary greatly in the time after mixing when they will bear the wires. Some brands of English Roman cement will set in two minutes; and some of Portland require over twelve hours. Cold retards the setting; and fresh ground cements set quicker than older ones.

Soundness.—Soundness refers to the property of a cement of not expanding or contracting, cracking or checking in setting. These effects may be due to free lime, or to unknown causes.

It is tested by preparing two cakes as above with thin edges. One of these is immersed in water and examined from day to day to see if it becomes contorted, or if cracks show themselves at the edges. The remaining cake should be kept in the air and its color observed, which for a good cement should be a uniform bluish gray throughout, yellowish blotches indicating poor cement. The color of the cement, when left in the air, indicates the quality much better than when the cement is put in water.

Tests of soundness should not only be carefully conducted, but should extend over considerable time; occasionally cement is found which seems to fulfill the usual tests for soundness, strength, etc., and yet after considerable time loses all coherence and falls to pieces.

"All cement mortar expands on setting, but the increase in bulk in any dimension does not exceed .001 part of that dimension, which is too slight to be of any consequence."

Fineness.—The question of fineness is wholly a matter of economy. Cement, until ground, is a mass of partially vitrified clinker which is not affected by water, and which has no setting powers; it is only after it is ground that the addition of water induces crystallization. It therefore follows that the coarse particles in a cement have no setting power whatever, and may, for practical purposes, be considered only as so much sand, aggregate or practically an adulterant.

There is another reason why it should be well ground. A mortar or concrete is composed of a certain quantity of inert material called "aggregate" which is bound together by a cementing material, the matrix, and it is evident that, to secure a sound mortar or concrete, it is essential that each piece of aggregate shall be entirely surrounded by matrix, so that no two pieces are in actual contact. It is hardly necessary to explain that the finer a cement is ground, the greater surface will the same weight cover, so that the finer a cement is ground the more economical will it be to use.

From which it appears that the finer a cement is ground, the better. Fine cement can be produced by the manufacturers in three ways; by supplying the mill-stone with comparatively soft, underburnt rock, which is easily reduced to powder; by running the stones more slowly, so that the rock remains longer between them; or by bolting through a sieve and returning the underground particles to the stones. The first process produces an inferior quality of cement, while the second and third add to the cost of manufacturing.

It is possible to grind a cement to any degree of fineness, but there is a degree of fineness which is most economical; this point is reached when it becomes cheaper to use more cement in proportion to the aggregate than to pay the extra cost of additional grinding. The degree of fineness of a cement is determined by measuring the per cents. which will not pass through sieves of a certain number

of meshes per square inch. The committee of the American Society of Civil Engineers recommend the determination "by weight of the per cent, that is rejected by sieves of 2,500, 5,476, and 1,000 meshes to the square inch respectively, the first mentioned sieve being of No. 35, the second of No. 37, and the third af No. 40 wire gauge."* These sieves are usually referred to by the number of meshes per linear inch; the first one above being known as No. 50, the last as No. 100. It is stated that as sold, the number of meshes vary somewhat, and that the number of wires is generally less, by about 10 per cent. than the number of the sieve. The diameter of the holes is about equal to the diameter of the wire.

German Portland cements are commonly finer ground than English. Most English manufacturers grind their cement to such a degree of fineness that when sifted through a sieve having 2,500 holes (50 by 50) to the square inch, it shall leave a residue of not more than ten per cent. by weight. Cement ground to this fineness will leave from nineteen to twenty per cent. of residue on a 4,900 (70 by 70) sieve, and practically nothing on a 625 (25 by 25) sieve; this is supposed to be the most economical degree of fineness.

Different brands of Rosendale cement vary considerably in their fineness. Those of the best reputation will leave from four to ten per cent. residuum in the No. 50 sieve; other brands will in the same sieve from ten to twenty-three per cent.

STRENGTH.—The strength of cement mortar is usually determined by submitting a specimen of known cross-section to a tensile strain. The reasons for adopting tensile strains that it requires comparatively light strains to produce rupture; and that, since mortar is less strong in tension than in compression, in most cases of failure of mortar, it is broken by tensile stress.

The form of the specimen to be tested, the briquette is about 3 inches long of 1 square inch section at the center and a little larger at each end for convenience in applying the breaking stress. For elaborate details concerning the form of specimen, the testing machine, etc., see ENGINEERING NEWS, Vol. 14, pp. 388-90. If this elaborate apparatus is not at hand, the tests can be made with very fair results by moulding the briquettes in wooden moulds, which have previously been well shellacked, and breaking them with a simple lever instead of the better cement testing machine. The important thing to bear in mind is that the briquette must be subjected to tensile strain only, and not to bending, that the stress must be applied gradually and without shock. The former is obtained by suspending the specimen between wood cushions or collars which are pivoted or free to swing in any direction. The latter can be obtained by suspending a pail from the arm of the lever and adding weight by allowing a stream of water or dry sand to flow into it.

It is customary to test some briquettes made wholly of cement, and also some composed of sand and cement; this gives a check upon the tests for fineness. Fine ground cements, as compared with those coarser ground, will give lower results tested neat, and higher ones with liberal proportions of sand.

"For tests of mortar, composed in part of sand, the sand should be sharp, well washed and dried, rejecting all that will not pass the sieve of 400 meshes to the square inch, and that will pass a sieve of 900 meshes to the square inch; the wire guage of the former sieve to be No. 24, and of the latter No. 28. The proportion of sand for mortar of each briquette should be carefully determined by weight and thoroughly and intimately mixed with the cement in a dry state before water is added, and, so far as possible all the water of mixture should be added at once that is necessary to produce the desired consistency of the resulting mortar, and thereafter the manipulation by the spatula or trowel should be rapid and thorough, and care should be taken to introduce the mass into the moulds and complete the moulding process before incipient setting begins."

The moulds while being charged and manipulated, should be laid on glass, slate, or some non-absorbent material. The moulds should be removed when the briquettes are hard enough to stand it; the briquettes should be immersed in water at the end of twenty-four hours, and should be tested as soon as taken from the water.

For Portland cement it is customary to break part of the briquettes at the end of seven and the remainder after twenty-eight days, As it is often impracticable to wait twenty-eight days, tests are some times made at the end of three and seven days respectively. The ultimate strength of the cement is judged by the increase in strength between the two tests. Neat Portland, at the end of the first day should carry 100 pounds per square inch, 175 at three days, 300 at seven days, 400 at a month, 470 at six months, and 490 at twelve months.

Since the American cements are quick setting, it is customary to immerse the briquettes in water immediately on removing them from the moulds, and break part of them at the end of the first day and the remainder after seven or twenty-eight days according to the time available. Neat Rosendale should carry seventy pounds per square inch at one day, ninety at seven days, 145 at a month, 280 at six months and 290 at twelve months.

For additional detail and much valuable information, see the report of the American Society of Civil Engineers, republished in ENGINEERING NEWS, vol. 14, pp. 388-90, and report of tests made at Boston Main Drainage Works, republished in ENGINEERING NEWS, vol. 14 pp. 1-4.

*Trans. Vol. 13, p. 54.

Trans. Am. Soc. of C. E. Vol. 14, p. 144.

PERSONAL.

ALONZO H. GORTON, Fall Brook Coal Co. R. R. Superintendent died at Corning, N.Y. April 26.

EDWARD M. TAYLOR, editor and manager of the *Railway Herald*, of Buffalo, died at Rochester, April 24 at the age of 38 years.

JAMES A. BELL, of the firm of Bell and Campbell has been appointed City Engineer of St. Thomas Ontario.

A. M. WHITE, Superintendent of the New York Locomotive Works, of Rome, N. Y., has accepted, the position of Assistant Superintendent of the Schenectady Locomotive Works, to take effect in May.

MR. JAS. MCNAUGHTON, formerly of the firm of Osgood & McNaughton, of Albany, delivered a very interesting lecture recently in Albany on the subject of the "Alert" Expedition to Hudson's Bay in 1886, of which expedition MR. MCNAUGHTON was a member. We have already referred to the purposes of this survey.

JAMES P. NELSON, has received the appointment of Assistant engineer on the Chesapeake and Ohio Railroad, to fill a vacancy caused by the death of the unfortunate young Quimby who was recently drowned as reported last week. Mr. Nelson was recently appointed to a similar position on the Richmond and Danville R. R., but resigns it for this position, which is more remunerative.

H. P. M. BIRKENBINE, formerly Chief Engineer of the Philadelphia Water Department died April 21. He was born in Reading in 1819 and came to Philadelphia in 1844. He was a machinist and hydraulic engineer by trade. While a member of the firm of Birkenbine & Trotter, the deceased took part in the erection of a number of gas and water works throughout the country, among those in Philadelphia being the Germantown Gas and Water Works and the West Philadelphia Water Works. In 1857 he was elected chief of the Water Department.

MESSRS. W. H. BREITHAUPT and KENNETH ALLEN, Civil Engineers, have formed a co-partnership and opened an office at corner of Main and 5th streets, Kansas City, Mo., as Civil Engineers and Contractors. Their professional references are of the very best, and in a well-prepared circular they state the special lines of work for which they solicit commissions. We are glad to notice these evidences of enterprise on the part of civil engineers, and we hope the new firm will be favored with the encouragement to which their experience and education entitles them.

COL. ABNER TIBBETTS, President of the El Paso, St. Louis & Chicago R. R. Co., died in a Pullman coach, April 25th, near Fresnillo, Mexico. COL. TIBBETTS was on the way to the city of Mexico, in company with ex-Secretary Windom, of Minnesota, who also is connected with the building of the road named. COL. TIBBETTS came to Texas from Minnesota, and was connected with railroads in that State and also with the famous Topolavampo enterprise. He was in bad health, and death is supposed to have been occasioned by heart disease, brought on by the high altitude of the portion of Mexico through which the train was passing, 9,000 feet above the sea.

A board of officers to consist of COL. THOMAS L. CASEY, LIEUT. COL. W. P. CRAIGHILL and MAJ. G. L. GILLESPIE is appointed to meet in Washington, D. C. April, 26th, for the purpose of determining whether the moneys already raised, together with the sum appropriated by the act of February 8, 1881, shall be sufficient to complete the proposed Bennington Battle Monument in accordance with the design which has been approved by the President. The board will submit its report to the President through the Secretary of War.

WE are indebted to the courtesy of MR. J B. HOEING of Lexington, Ky., for a series of maps illustrating the Geological Survey of the State of Kentucky. These maps, drawn by Mr. HOEING, are most beautifully executed on a scale of two miles to the inch, with conventional colors to represent the geological features, and with the usual signs to represent the streams, roads, railroads, Indian Mounds, houses and county lines. Mr. R. PROCTOR is Director of the Survey and W. M. LINNEY is the Geologist. It is a great pleasure to us to receive such fine specimens of American Cartographic work and we are very much obliged to the donor.

THE following changes in the engineers corps have been ordered: First. Lieut. Wm. M. Black ordered from St. Augustine, Fla., to Jacksonville, Fla., relieving Capt. W. T. Rossell, who is ordered to Memphis, Tenn., relieving Capt. Clinton B. Sears, and as a member of the board of engineer officers on buildings and repairs of levees of the Mississippi river, reporting to Col. Gilmore for duty, in charge of the third district of the river.

Capt. Sears had been ordered to Willet's Point, N. Y., for duty with the batallion of engineers and at the school of application. Capt. Thomas W. Symons will be relieved from his duty in this city on or before June 1, and is ordered to St. Louis, relieving Capt. Joseph H. Willard, and reporting for duty as secretary and assistant to the construction committee of the Mississippi River Commission and disbursing officer of the works under the commission.

Capt. Willard has been ordered to Vicksburg, relieving Capt. Eric Bergland, who has been ordered to Willet's Point, N. Y., for duty with the batallion engineers and at the school of application.

CIVIL ENGINEER ROBERT E. PEARY, U.S. NAVY, being of that adventurous turn of mind common to all explorers, has determined to spend a year's leave of absence, which he has recently secured from the Department, in exploring Greenland, the interior of which is almost unknown. Mr. Peary is sceptical as to the report that the interior is covered up with ice and snow. His impression is that somewhere in the center of the country there is land uncovered the greater part of the year, where live people entirely unlike the Esquimaux. This conclusion he bases on the theory that the reindeer which come down to the coast in the vicinity of Disco in the winter and disappear inland in the spring, not to return again until late in the year, must find grass or vegetable food of some kind in the interior to live upon during the summer. He overlooks a possibility that they may winter in Symmes's Hole. Mr. Peary has been in Washington for several weeks arranging for his expedition. He expects to sail by one of the whaling vessels from St. John's to Disco early next month. From there he begins his explorations, travelling on foot. Sledges for provisions only will be used. These will be drawn by three men with whom he has arranged to accompany him. Mr. Peary makes this expedition entirely at his own expense.—*Army and Navy Journal.*

Engineers' Club of Philadelphia.

Record of Regular Meeting, April 17, 1886.

President Washington Jones in the chair; 27 members and 1 visitor present.

Mr. J. S. Elliott presented a discussion of the recent paper by Mr. C. W. Buchholtz upon "Engineering; Its Achievements and Its Reward."

Mr. H. W. Sauberan made some remarks on "Recent Stream Gauging for the Future Water Supply of Philadelphia," describing the methods used, and why they were adopted, illustrated by numerous drawings and photographs, and the automatic recording gauge. The streams gauged were the Perkiomen creek and tributaries in Montgomery county, the Neshaminy and tributaries and the Tohickon in Bucks county. The original intention was to gauge the minimum flow only, and for that purpose weirs were constructed on eight different streams. They were very substantially built, as they had to withstand the run of ice in the spring of the year. Heavy bed logs were placed at the level of the bed of the stream, and the superstructure built on that. They were made water-tight either by sheeting placed below the bed-log, to rock bottom, or a cement mortar wall. The crests of the weirs were generally about 2 feet above the beds of the streams, and were made of 2-inch oak plank. Gauge boards were placed about 5 feet above and below the weirs, and connected, by levels, with the same. The one above indicated the depth of water on the crest. The one below, was used only in case the weir was submerged by high water. The weirs varied in length from 15 to 70 feet, according to the width of the stream. The formula used for calculating the flow over the weir was the one by Fteley & Stearns, of the American Society of Civil Engineers. Steam gauge stations were established near the weirs. Readings were taken there at the same time they were at the weirs. When a sufficient number of readings, at various heights, were made, "a curve of flow" was plotted by comparison of the two. Then, when the crests of the weirs were removed for the winter, the flow was found by referring the stream gauge readings to the "curve of flow."

The great fluctuation in the flow of the streams, caused by the great number of mills on them, necessitated a great many observations at the weirs to get a correct gauging. This difficulty was overcome by the use of automatic gauges. They were run by clockwork, and drew a line on a roll of paper, corresponding to the rise and fall of the stream. Two descriptions of gauges were used. One was designed chiefly by Mr. Stierle, of the U. S. Engrs. Office, Philadelphia. The minimum flows were found to be so small that the larger flows had to be determined. These had to be found by other methods, for the weirs would only carry, at the most, 2 feet in depth, while the water in streams sometimes raised as high as 16 feet. The measurements of the large flows were made mostly by the use of electric current meters. The measurements had to be made from bridges, and where none existed, in proper places, small suspension bridges were put up. One was built over the Perkiomen, at Frederick, of 120 feet span, and one over the Neshaminy, at Rush Valley, of 133 feet span. By means of the meter, the velocity of the water was taken at a great number of places in a line across the stream, and a close estimate of the velocity of the whole cross section determined. Stream gauges were placed near the meter stations, to read when measurements were made, answering the same purpose as those connected with the weirs.

In some cases, large flows were measured by getting the velocity of the stream, by means of pole floats. When used, care was taken to have the length of them as near the depth of the water as possible, and they were run at as many stations across the stream, as was necessitated by the changes in the even flow of the stream. The rise and fall of the water during freshets was so sudden, and the stations, eleven in number, were so scattered—the water-sheds covering five hundred square miles—that it was impossible to get to, and make measurements of, more than one or two streams during a freshet. Then, many times, the freshets would come in the night, and nothing could be done but the taking of continuous readings of the stream gauges.

To overcome these difficulties with our small force, and get at least fair measurements of all the streams at the high point of a freshet, "maximum stream gauges" were set up on most of the streams. A place was chosen where the bed of the stream was uniform in width and slope, and two similar gauges set up. They were usually from 200 to 500 feet apart. They were made in the form of a box from 8 to 12 feet long, and 6 inches square inside. One side opened as a door. They were placed on end and shielded and supported by heavy timbers, imbedded in the soil or bolted to the rock bottom. Vertically through the center of the box ran a brass rod, which was graduated. A metallic float ran on the rod in such a manner that it would rise with the water, but would remain fixed on the rod, at the highest point the water reached, after it had fallen. The two gauges were connected by levels, and from the gauge readings the slope of the water was determined. From this the velocity of the stream was found by the Kutter formula. The daily flows of all the streams have been tabulated, from the commencement of the gauging in July, 1883, to January 1st, 1886, and the field is still being continued. The daily flows have also been shown graphically on sheets, with the rainfall on the water shed and the temperature annexed. The connection between the three is well shown. Rain-gauge stations were established over all the water sheds, and the data obtained from them, combined with that from previously existing gauges, which was kindly furnished us by the observers, have also been plotted graphically, showing plainly the variations of the rainfall over large areas. Three automatic rain-gauges were used to show the intensity of the storms.

Mr. E. V. d'Invilliers spoke upon the geological position, characteristic features and method of mining the ore at the Cornwall Iron Mines, Lebanon Co., Pa., illustrating his remarks with several maps and cross-sections, and a relief model of the mines and contiguous territory, constructed by Mr. A. E. Lehman.

The ore deposit occurs in three hills, five miles south of Lebanon, whose summits are 870, 715 and 700 feet A. T., (above tide) Lebanon being 471 feet A. T., and Cornwall, at the base of the Middle Hill, 575 feet A. T.

The extreme length of this magnetic ore deposit is 4,400 feet in a general east and west line; its breadth in Big Hill 400 feet; in Middle Hill 800 feet, and in Grassy Hill 600 feet; and its area is about sixty-three acres.

The ore is surrounded on three sides by a steeply sloping wall of dolerite (trap) rock 100 feet ± thick, the Mesozoic sandstone abutting against the southwest dipping ore on the south side of the deposit.

The ore was referred to the lime-shale transition layers between the Siluro-Cambrian limestone and the Hudson river slates; is magnetic, practically free from phosphorus, but contains considerable sulphur and some copper, and, except in the soft surface ore, all requires roasting before it is worked in the furnace.

There are three commercial grades of ore; but the bulk of the output is the No. 3, "selected ore," mostly lump, with about 48 per cent. of iron and 2.5 to 3 per cent. sulphur.

Mining at present is carried on entirely above water level, though the records of several bore holes have established the great depth of this deposit beneath the water plane; bore hole No. 4, in the east end of Middle Hill, being down 325 feet below the surface, or to 282 feet A. T., without any trap or other foot vein being struck.

The ore is mined in successive terraces and stopes, as in hugh open quarries, and, by means of six compressed air drills, large quantities can be mined upon short notice. The output for the year 1885 reached 508,864 tons, 6 cwt., and the total to January 1st, 1886, in round numbers, 7 *million tons*. Probably 30 million tons still remain *above* water level, before there will be any necessity to tap the underground deposit.

Mr. d'Invillier's paper upon the subject was read at the Pittsburg meeting (February, 1886), of the American Institute of Mining Engineers, and will appear in Vol. XIV of their Transactions. His remarks were preliminary to a description of the model, by Mr. Lehman.

Mr. A. E. Lehman then exhibited, and described the method of construction of the model of the above mine. It is built entirely of layers of cardboard, the perpendicular edges of which are brought to slope by engraving tools. It was so constructed that the accurate location of the contour lines was preserved, and they were drawn in ink on the finished surface, adding greatly to its practical value and intelligibility. Property lines, railroads and other topographical features and areas are shown in ink and color. The whole work is one of remarkable neatness.

HOWARD MURPHY,
Secretary and Treasurer.

Liverpool Engineering Society.

The usual fortnightly meeting of this society was held on Wednesday, 7th ult. at the Royal Institution, Colquitt-street. Mr. Coard S. Pain, A. I. C. E., in the chair.

A paper was read by Mr. W. E. Mills, entitled, "Notes on the damage sustained by a large building from subsidence and the means taken for its support." The author, in the course of his remarks, described the gradual extension of the various indications of the settlement of the building from the first faint appearances in the vaults underneath the footway of the adjacent street to the ruptures in the main external and internal walls, which at last became so serious that the local authorities intervened. It was now requisite that the front face of the building should be supported and as much weight as possible taken off the foundations. The authorities required that whatever "shoring" was introduced should not obstruct the footway, and the owners desired that access to the building should not be interrupted. Hence the ordinary methods of "shoring" were inadmissible, but the difficulty was overcome by means of a special arrangement of timber supports or "shores," which the author described in detail. The state of the building continued to become worse, and a portion was at length condemned by the authorities and ordered to be taken down. It was found that the necessary requirements would be met by removing the main outer walls, but it was stipulated that the use of the building must be preserved while the work was being executed and the inmates interfered with as little as possible.

The author then described the means by which this was accomplished, a timber wall or partition being built up inside the main wall, so that when the latter was pulled down the timber partition took its place, and the work was thus completed without interrupting the ordinary course of business carried on in the building for a single day.

WATER

LAKE CITY, COL., is to be lighted by electricity.

KENT, O., will have water-works.

SPEARFISH, DAK., has voted $25,000 for a water-supply.

THE legislature has empowered the Warsaw, N. Y., Water-Works Company to increase its capital to $50,000.

THIRTY thousand dollars have been appropriated for the extension of the Providence, R. I., water-works.

LIMA, O., proposes to issue bonds and establish water-works.

BATTLE CREEK, MICH., has voted to bond the city for $100,000 for water-works.

THE Columbus, O., City Council has ordered an investigation of the water-works department.

THE Massachusetts Senate and House recently visited the improved sewerage works of Boston.

ADAMS, MILLER & Co., Rome, N. Y., will build the Cambridge water-works.

THE American Steam Heating Company has been incorporated at St. Louis, with a capital stock of $20,000.

ABERDEEN, MINN., has a civil engineer looking over the ground with a view to putting in a system of sewerage which is needed badly.

WORK was commenced on the Crawfordsville, Ind., water-works April 21. Councilman F. Bandel has the contract for all the stone work.

PRAIRIE CITY, ILL., having started a milk wagon, a Boston paper predicts that water-works will be the next move.

THE Ashland, Wis., Lighting Company is putting in a first-class electric light plant. The light is to be in operation by May 1.

THE citizens of Marca, Mason county, Ill., have formed a stock company and have commenced boring for coal.

AT Cranston, R. I., a motion was made that a civil engineer be engaged for one year, whose pay should be $300 for the term.

WATER-WORKS are to be constructed at Wabash, Ind. Jesse Starr, Jr., St. George's Hotel, Philadelphia, Pa., has the contract, and has commenced work.

THE water company of Wakefield, Mass., has been authorized to issue bonds and secure them by a mortgage on its franchise and other property.

THE gas companies in Brooklyn, N. Y., observing the great increase in the demand for electric light, have applied to the State Legislature for power to furnish electric light as well as gas.

WORK has just been commenced on the Abington-Rockland water-works. Rockland will have twelve miles of pipe and seventy hydrants, and Abington ten miles of pipe and sixty hydrants.

COXE BROS. & Co., Drifton, Pa., have a plan under consideration to convey the water supply for Drifton from the springs above Eckley. The project will cost $30,000.

THE Worcester Water Gas Company, Portland, Me. Capital stock, $100,000. President, G. G. Hackett, Wakefield, Mass.; Treasurer, Wm. H. Phipps, South Framingham, Mass.

THE new water-works of the Home Water Co. are rapidly progressing. The new pump house is almost finished and the machinery is on the ground ready to be placed in position.

A SUIT has been commenced by Mr. J. H. Haney, as agent, against the Hot Springs, Ark., Sewer Commissioners to collect a royalty from them for the lease of the Waring system of sewerage which they are putting in.

ELECTRIC lights are to be introduced into Malden, Mass. A. E. Bliss, of Malden, is interested.

THE city council of Shreveport, La., has appropriated $500 for a survey of the city with a view of building water-works, and a Boston engineer has been sent for.

THE United States Electric Light Company will build a line in Seabright, N. J. A building to contain machinery will be erected.

THE Pulaski Gas Light Company is enlarging the works by the erection of a new receiver and adding to their producing capacity; they will expend about $20,000.

SWAMPSCOTT, Mass., asks Lynn for a water supply for five years. The Marblehead Water Company is a competitor of Swampscott's trade.

THE Greencastle, Ind., Electric Light Company has awarded the contract for its apparatus to the Jenney Electric Company, of Indianapolis. The installation will be made immediately.

THE Water Commissioners, of Ware, Mass., have organized with Charles C. Hitchcock as Chairman and Dr. E. H. Guild, Secretary and Treasurer. F. L. Fuller, of Boston, has been engaged to make surveys and draw plans.

THE firm which had secured the contract to erect water-works at Clinton, Mo., having refused to go on with the work; the contract has been cancelled and new bids are being received.

MR. ROBERT HAWKINS, the Superintendent of the Hyde Park, Ill., water-works, has left for Lockport, N. Y., to examine and test the working of the new Holly engine for the Hyde Park works.

THE Silver Cliff Water Supply Company has filed articles of incorporation at Denver, Col. The incorporators are Joseph Standley, Willard Teller and Frank C. Young, and the capital stock is $35,000.

PARKERSBURG, W. Va., is agitating a scheme to have the city lighted by the electric light. The city is in correspondence with the Schuyler Electric Light Company, of Connecticut.

THE artesian well at Plankinton, Minn., has sufficient flow at 680 feet to be pronounced a success, but it is designed to go about 400 feet deeper. It is thought there will be power enough to run electric lights and for other purposes.

THE Brush Electric Light Co. agrees to furnish Batavia, N. Y., sixty lights, ten to burn all night, for $6,000 and the Gas Co. agrees to furnish sixty lights to burn all night for $5,475, and as the matter looks now Batavia will be lighted by electric light.

THE Beverly, Mass., water-works committee asks proposals for two 2,000,000 gallon capacity pumping engines, with boilers and foundations, for the new supply. Bids will be received by the Water Committee, P. E. Clark, secretary, until May 10.

BISMARCK, DAK., April 22.—E. H. Bly returned from the East to-day, where he has been negotiating for the construction of a system of water-works, for which he has a charter. It is understood that work will be commenced at once. Over $100,000 will be expended.

CHARLOTTE, MICH., has decided to let the contract for furnishing the machinery, pumps, engines and laying the pipes for water-works to McWalker, of Port Huron, for $33,468. The city is to purchase the pipe, build the engine house and complete the wells. Cast-iron pipes will be used.

THE contract for constructing water-works for the city of Charlottetown, Prince Edward's Island, has been awarded to the Charlottetown Water-Works Company, of which Mr. Thomas Turnbull, of Montreal, is chief stockholder. The sum to be paid for the use of sixty hydrants under the contract is $3,000 per annum.

THE Trustees of the village of Sing Sing have organised themselves into a Board of Water Commissioners, with George A. Brandreth as President, Isaac Terwilliger as Secretary, and Isaac B. Noxon as Treasurer. Plans and surveys have been prepared by a water company, and they will be examined by the Water Commissioners.

THE Pond Engineering Co., St. Louis, has been awarded the contract for the pumping machinery of the Mt. Vernon, Ind., water-works. It will have a capacity of 2,000,000 gallons in twenty-four hours. The contract for the construction of the works has been awarded to W. S. Kuhn & Co., Pittsburg, Pa. The award is $3,500 per annum for seventy-five hydrants.

THE Rhode Island Water Gas Company has been incorporated at Portland, Me., with the following officers: President, James W. Treadwell; Treasurer, Alfred J. Cunningham; Directors, J. G. Stewart, Jr., G. G. Hackett, A. J. Cunningham, James W. Treadwell, F. M. Upham, John D. Hopkins, James H. Russ, Frank P. Stone, William Austin. Capital stock, $500,000.

A REPORT is current that electric lights will be placed in the cars of the Brooklyn Elevated Railroad.

The Northboro, Mass., Water Commissioners' report for the past year shows the present length of main and distribution pipe to be 8¾ miles; total cost of works, $66,991.84; town debt therefor, $61,500; interest, $2,460 per annum and that amount paid from rates last year; number of hydrants 51 and gates 50; collected from water takers for year ending Feb. 13, 1886 $9473.39 cost of maintenance for past year, $333.16.

THE Daft Electric Power and Light Company, of Missouri, has filed articles of incorporation at Belleville, Ill. The capital stock of the company is $300,000. The incorporators are Christain Peper, John Scullin, C. O. Godfrey and E. C. Rice, of St. Louis; T. D. Ripley and H. G. Bond, of New York City, and R. W. Haakerswoot, of East Orange, N. Y. A branch office will be opened in East St. Louis.

WOODLAND, Cal., with 5,000 inhabitants, is the smallest town on the Pacific coast using the electric light. Mr. O. I. Cheeney has put in a Thomson-Houston plant for a local company having a capital of $10,000. The dynamo capacity is fifty arc lamps, of which about forty-five are already in use or ordered. At present power is hired, but the directors have bought ground for a station and contracted for a fine Armington & Sims engine. May 1st the company will bid on city lighting.

H. M. HEATH, Council for the Augusta, Me., Water Company, has made a proposition to the City Council to establish a new water system, furnishing eighty hydrants to the city for twenty years at an annual rental of $3,000 and $1,500 annually for the next twenty years. Exemption from taxation was not asked for. The system proposed is the gravity and Holly systems combined. Water will be pumped at Kennebec dam by powerful pumps, with a capacity of 2,000,000 gallons daily, to a reservoir capable of holding 6,000,000 gallons. The reservoir will be increased to 8,000,000 if the topography of the ground will permit. The entire city will be piped, and the head of water will be 240 feet.

THE Crawfordsville, Ind., *Review* remarks on the mania for water works which has broken out in that State. It calls attention to the fact that the builders are always to own the works, and exact of each city $5 000 per year rent; while very few cities are to own their own works. It adds "It is remarkable to observe the almost general dissatisfaction that exists toward them where they have heretofore been constructed. They do not do what had been promised or anticipated of them. It is a luxury that costs too much, apparently." Further it remarks that the water works seem to be a matter of speculation with the builders. Cities proposing to have water works would do well to proceed carefully if they wish to avoid disappointment and trouble.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

The Missouri River & Northern R. R. will be built this season from Pierre, Dak., to La Moure.

California & Oregon R. R.—A force of 3,000 men is at work on this extension of the Central Pacific R. R.

Paris Metropolitan R. R.—Of the 20.5 miles of the newly authorized system, 9.5 miles will be on viaduct, 3 miles in open cut and 8 miles in tunnel.

Des Moines, Osceola & Southern R. R.—It is proposed to widen the gauge of this road and extend it to Kansas City.

The Virginia Midland R. R. has been formally transferred to the Richmond & Danville Railway Company under a lease of ninety-nine years.

The Mexican Congress is considering formally a bill providing the death penalty for all offenses against railways and trains.

The Richmond & Chesapeake Railway Co. talks of building a tunnel at Richmond, Va., to cost over $1,000,000.

The Creeping of Rails on the St Louis Bridge, by J. B. Johnson, St. Louis, Mo., published in ENGINEERING NEWS, January 3rd, 1885. PRICE, 10 CENTS. Illustrated.

WASTE WATER PREVENTION AT FRANKFORT-ON-MAIN, GERMANY. Published in ENGINEERING NEWS, May 2nd, 1885. Also CAISSON SINKING, AT THE HAVRE DE GRACE BRIDGE, Md. Illustrated. PRICE, 10 CENTS.

The Milwaukee, Lake Shore & Western R. R. has filed a resolution with the secretary of state for Wisconsin of its intention to construct a branch road from its main line at Hurley southwest along the Gogebic iron range for a distance of nine miles, all in Ashland county.

The Lynchburg, Halifax & North Carolina Railroad Co., incorporated in Virginia, has been organized with Peter J. Otey as President, and Wood Bouldin, Jr. Vice-President.

A Land without Railroads.—There are no railways in Persia; the land of the Lion and the Sun has not a single mile of railway. The Shah is said to be afraid of railways, as they might be used against him in case of war.

The Coney Island Elevated R. R.—Counselor John H. Clayton, referee in the foreclosure suit against the Coney Island Elevated Railroad, sold the property April 21. It was bought in for $10,000 by a committee of the bondholders who will re-organize and manage the road.

A Deadwood Railroad.—New York capitalists propose to build a standard gauge line from Deadwood, Dak., to the Wyoming coal fields, with narrow gauge extensions from Deadwood to the neighboring mining camps.

An Adirondack Railroad.—A new railroad is projected, making connection with Albany, and running through the Adirondacks to Belmont, Franklyn county. Mr. John C. Sheenan, of Buffalo, has been examining the maps of this region but no definite plan has yet been made.

Fort Worth & Denver R. R.—Orders have been issued for the extension of this line fifty miles from Harrold, its present terminus, in Wilbarger county to Quanah, in Hardeman county. This road is now being extended southeast from Fort Worth to Corsicana, where it connects with the Houston and Texas Central R. R.

Ohio & Kanawha R. R.—At a meeting of the stockholders of the Ohio & Kanawha and the Kanawha & Ohio railway companies, recently, the two corporations were consolidated, with a capital stock of $12,200,000. This deal gives the new company a line from Charlestown, W. Va., to Corning, by using the old Ohio Central R. R.

Chicago & Great Southern R. R.—The directors have instructed General Manager Kimball to at once organize forces to relay the track with new steel rails between Attica and Yeddo, to complete the fencing on the entire line and to finish the ballasting between Goodland and Wyndham. Roadmaster Nichols has received orders to commence laying steel and ballasting and to complete the filling of trestles. It is the intention to put the track, bridges and trestles in first-class order by June 1.

A Pennsylvania R. R.—Philadelphia capitalists have offered to build a railroad from Mapleton station on the Pennsylvania R. R., to Rocky Ridge near Cassville, if the right of way through Smith's Valley be obtained without cost. The proposition has been accepted by the people of the Valley and a committee has been appointed to procure the necessary grants from landowners. This road will reach an undeveloped part of the Broad Top coal fields.

A Model Bridge.—One bridge across the Elkhorn river between Nickerson and Hooper, built within a year or two, furnishes a good sample of the skill and care displayed in building bridges in Dodge county. The piles, instead of being put down the required depth, were sawed off and the ends just put into the sand a foot or two. When the river rose the sand was cut out and the piles, which had been bolted to the bridge, were left dangling in the air. There has been too much economy of strength and too little economy of money in these matters.—Fremont, Neb., *Tribune*.

St. Louis, Arkansas & Texas R. R.—About 75 miles of track between Waco and Texarkana have been widened to standard gauge, and the work is progressing. All the narrow-gauge engines are to be put in thorough good order, after which they will be advertized for sale. To replace them a contract has been closed with the Baldwin Locomotive Works for sixty standard-gauge Mogul engines and eight standard-gauge mail coaches. These are to be ready early next fall and winter.

Plant on the Panama Canal.—The following is a list of the plant now in use on the canal:

Locomotives, European	200
" American	60
" 3.5 tons	8
Excavators, European	105
" American	11
Dredges, 60 H. P.	4
" 180 H. P.	22
" for deep water	3
" American	7
Hopper barges	10
Pontoons	4
Conveyers	22
Locomobiles (?)	97
Portable engines	34
Steam cranes	500
Tow-boats	28
Floating shears	1
Steam pumps	144

A Jersey City Tunnel.—The Governor of New Jersey has signed the bill for the building of a tunnel instead of a bridge at the gap in Washington-street, Jersey City. Representatives of the sugar house which has fought for 15 years against the bridge scheme say that the tunnel will be begun at once and completed in a few months, at no greater cost to the city than a bridge would have been.

The Vosburg Tunnel.—The Lehigh Valley R. R. in following the course of the Susquehanna river above Tunkhannock encounters a heavy curve round the base of the mountains, and in order to obviate the necessity of passing round this curve—a distance of five miles—a tunnel has been constructed at a point where a narrow neck of land intervenes between the ends of the curve. Work was commenced in the spring of 1883 and is now approaching completion. The tunnel is about 3,900 feet long, 23.5 feet in height and 29 feet in width: owing to the treacherous formation the roof was timbered and is finished in brick; the abutments are of limestone. The cost of the work, which is about 37 miles above Wilkes-Barre, will probably be over $1,000,000. G. B. Owen is engineer in charge and the plans were prepared by him. T. P. Gaynor is inspector of masonry, etc. The contractors are C. E. Broadhead, Flemington, N. J.; L.F.Lentz, Mauch Chunk, Pa.; J. H. Byron and D. C. Hickey, New York.

Open Cut vs. Tunnel for Atlantic Avenue.—Col. John Y. Culyer, engineer of the Sixth Rapid Transit Commission, Brooklyn, has made a report to that body with regard to the proposed line on Atlantic avenue. He gives the comparative costs of a railroad in an open cut and a tunnel line. The length from South ferry to the city line is about five miles. A general plan for a depressed road provides for a permanent width of 36 feet between the inner face of the retaining walls. The material to be excavated being composed of gravel and sand mainly, the public must be temporarily deprived of the use of the street and business practically diverted during a period of at least eighteen months.

SUMMARY OF COST FOR A DEPRESSED ROAD.

	Per foot of road.
Excavations, including foundations and side or retaining walls, 50 cubic yards per lineal foot of roadway, at $1	$50.00
Retaining walls, including parapet walls, coping, railing, etc., at $10 per cubic yard	220.00
Alteration of parallel sewers	6.00
New water pipe	12.00
Steel rails, tracklaying, ballast, etc.	3.98
Bridges at intersecting streets, estimated at $5,000	11.00
Total	$302.98

Say $300x5,280, $1,584,000 per mile. For a tunnel the most feasible plan of construction to be adopted would be by an open cut afterwards covered in by I-beams and brick jack-arches. This work would also practically close the street during its progress.

ESTIMATED COST OF THE TUNNEL SCHEME.

Items of expense to be added to the cost per foot of a depressed road:

	Per foot.
I-beams, 270 lbs. to the yard, at 3¼ cents per pound	$32.55
Brickwork in arches	12.15
Asphalting arch, repairing roadway, etc., $3 per square yard	7.00
Total	$51.70
Deduct for bridges	11.00
	$40.70

Say $40 as representing increased cost per foot of construction for tunnel over that of a depressed road, which would give $211,200 as the excess per mile.

Cost per mile of depressed road	$1,584,000
Add additional cost per mile of tunnel	211,200
Or cost per mile of tunnel road	$1,795,200

CONTRACTING.

St. Paul, Minneapolis & Manitoba R. R.—The contract for building the Turtle Mountain extension has been let to Tracy & Haughen. Grading has been commenced.

Asphalt Paving Contract.—The Hastings pavement company of this city, has just completed orders for 40,000 asphaltum blocks and 100,000 tiles, for paving in Washington.

Iron Plates.—Messrs. Brown & Co., proprietors of the Wayne Iron and Steel Works, Pittsburg, have secured the contract for 100 tons of rolled safe plates to be used in the vaults of the new Gallatin Bank, Wall street, New York.

Jails.—Steps are being taken for the erection of a jail in Hastings, Neb., for Adams county. A county jail and addition to the poor-house will be constructed at an expense of $10,000 at Washington City, Wis. At a recent election the electors of Pennington county voted to issue $15,000 in bonds to build a county jail at Rapid City, Dak.

Abstract of Proposals for constructing a Dike in Delaware river between Hog and Maiden islands, received in response to advertisement dated March 22, 1886, and opened April 22, 1886, by Lieut.-Col. Henry M. Robert, Corps of Engineers United States Army.

No.	Names and Addresses of Bidders.	Approximate Quantities. Piles 1,000, linear ft. Per lin. ft. Cents.	Brush Mattress, 1,800 cu. yards. Per cu. yard.	Annealed Iron Wire, 3,000 lbs. Per lb. Cents.	Stone, 12,000 cu. yards. Per cu. yrd.	Total.	Remarks.
1	William M. Field, Kentmore, Del.	17	$1.75	3	$1.50	$21,410	
2	U.S. Dredging and Canal Construction Co., N. Y.	20	1.68	7	1.75	24,434	
3	B. G. Bailey, N. Y.	35	4.00	15	2.70	40,400	Informal.
4	Ira Lunt, New Castle, Del.	20	1.75	5	1.50	21,500	
5	H. S. Wright, Phila., Pa.	20	1.85	5	1.74	24,560	Informal.
6	R. Patterson & Son, Philadelphia, Pa.	14	1.68	3	1.58	22,214	
7	J. Satterlee, Englewood, N. J	19	1.65	3	1.61	21,490	Rec'd fo
8	John A. Bouker, New York	20	1.70	5	1.45	20,810	accep-
9	W. Danforth, Bergen Pt., N.J	15	2.10	5	1.84	26,160	tance.

Slag Paving.—Denver, Col., proposes to experiment with slag from the smelters for street paving material.

Notes from St. Thomas, Ont.—The contract for freestone flagging on Talbot street was awarded by the City Council at their last meeting to Rowan & Smyth of St. Catharines. It is the intention of the city officials to advertise for tenders for cedar block paving on several streets and stone paving around the markets and city buildings. Improvements are now paid for under the frontage tax system.

Beacon.—Captain James F. Gregory, light house engineer, opened bids at his office in Baltimore for the materials and the erection of a beacon at Cape Hatteras. The bidders were the Manley & Cooper Manufacturing Company, of Philadelphia, $2,700; James H. Coster, Baltimore, $3,459; H. A. Ramsay & Son, $1,980; William Mitchell, Fort Hamilton, N. Y., $3,500; Southwark Foundry and Machine Company, Philadelphia, $3,000; B. G. Bailey, New York, $3,333.

Railroad Extension.—The corps of engineers to run the line for extension of the Gulf, Colorado and Santa Fé R. R. to a junction with the Atchison, Topeka and Santa Fé R. R. in the Indian Territory, have begun work near Fort Worth, Tex. The contract for grading to Red river was let to Roche & Hurley. The Chief Engineer says the company proposes to cover the 170 mile gap by the 20th of November.

Coal Contracts.—The award of the contract for furnishing the Grand Trunk Railroad with coal a few weeks ago was made so secretly as to excite surprise among coal men. They were treated to another surprise recently when it leaked out that the firm of J. Langdon & Co. have captured the contract for the supply of the Michigan Central Railroad for the current year. The amount and quantity will be about 150,000 tons, and the price is said to be the same as last year, although it is believed that it was shaded somewhat. The coal will be delivered to the road at Black Rock and Suspension Bridge.

Jetty.—The following are the proposals to furnish material and labor for the construction of a jetty and wall protection at Cape Charles Light Station, Va.: Michael Z. Hammen, Baltimore, Md.; brush mattresses, per cubic yard, $3.20; log mattresses, per square yard, $1.05; rock, per cubic yard, $3.10. Francis H. Smith, New York City, $3.50, $1.00 and $4.44. George B. Chittenden, Washington, D. C., $3.00, $2.50 and $4.50. Holtzclaw Bros., Washington, $5.00, $1.50 and, $4.68. Wm. Mitchell, Fort Hamilton, N. Y., $5.25, $2.35 and $4.97. Edward H. Gaynor, Boston, Mass., $2.27, $1.37 and $7.93. James H. Coster, Baltimore, Md., $2.25, 97c. and $10.69. The contract has been awarded to M. Z. Hammen.

Sewers.—The St. Louis, Mo., board of public improvements have awarded contracts for sewering as follows: South Mill Creek sewer, district No. 36, to Wykoff & Cream, for $391.15; North Mill Creek sewer, district No. 20, to Robert Sheehan, for $6,143.30; Job street, district No. 8, to Fred Skrainka, for $4,011.10; Ferry street, district No. 9, to August Herman, for $10,918.80; Elliot avenue, district No. 36, to Robert Sheehan, for $2,512.30; North Chambers street, district No. 8, to George Pendergrast, $2,865.70; Illinois avenue, district No. 5, to H. H. Ruecking, for $2,777.85; Chestnut and Pine streets, district No. 3, to Bambrick A. Foster, $608.80; Northwestern district, No. 21, to H. H. Ruecking, for $2,958.70

Dallas & Greenville R. R.—GREENVILLE, TEX., April 21.—Bids were received to-day by Maj. Walthen to grade, tie and iron the Dallas and Greenville R. R. They were from the following parties: Harbing & Son of Galveston, Britton & Lyon of Sherman, Brigsby Bros. of Jefferson, Morgan Jones of Fort Worth and Whittaker & Galloway of Kildare. The bids were forwarded to Mr. Hoxie at St. Louis, and will be opened by him and the contract awarded. The work under the contract must begin by May 1, and the road completed with tie and iron to Dallas by September 1, 1886.

Naval Cruisers.—SAN FRANCISCO, April 22.—The Union Iron-works has forwarded plans and proposals to Washington for the construction of five naval cruisers, two of 5,000 tons each, one of 3,000 tons, one of 1,200, and one of 7,800.

Charleston Bridge Co.—Willis McCook, will go to Evansville, Ind., to represent the Keystone Bridge Company in its suit against the Charleston Bridge Company of Indiana and Kentucky for $80,000. The last-named company retained this sum because the Keystone did not fulfil its contract within the prescribed time, which the latter company claims was impossible because of high water.

Bridge Notes.—The Hudson Bridge Works have closed a contract to build an iron bridge over the Minekill Falls, at Gilboa, Schoharie county, N. Y. The iron structure will have a span of 100 feet, and will be 65 feet above the water.

The bill incorporating a company to build a bridge over the St. Lawrence river at Brockville, Ont., was passed by the railroad committee, April 20.

Commissioner Chatfield, of Prattsville, N. Y., has been authorized to build a new bridge across the Red Kill, and he has made a contract with a Cleveland, O., bridge company to construct the same for $1,050, to be completed by the 20th of June.

The new bridge of the I. D. & S. R. R., over the Sangamon river is completed, and trains are running over it. The bridge is in three spans, the main span being 160 feet long. The company has done a good deal of work in filling trestles and the approaches to the bridge.

The King Iron Bridge & Manufacturing Co., Cleveland, O., has on hand several large contracts among which is a double track viaduct over the L. S. & M. S. R. R. and C., R. I. & P. R. R. tracks in Chicago; also a viaduct in Cleveland, the superstructure of which will be about 4,000 feet in length, and total cost of bridge about $1,000,000. The company has also just completed a 200 feet draw for the same city.

The Board of Selectmen, Morrisville, Vt., will have an iron bridge put up to replace the one recently swept away.

The bridge at Oneonta, N. Y., will be rebuilt. Address DeWitt C. Yager.

The Chicago, Burlington & Quincy R. R. shops at Aurora, Ill., have completed a draw-span 195 feet long for the new bridge at Quincy, Ill. The bridge will be 600 feet long.

The Boston and Providence R. R. Company will build a new bridge at Hyde Park. Address A. A. Folsom, general superintendent, Boston, Mass.

The contract for an iron bridge over the Tioughnioga river, at Cortland, N. Y., has been awarded to S. Twiss, agent for the Canton, O., Wrought-Iron Bridge Co., for $6,100. There were five other bids, the highest was $6,550.

Paquet & Smith, of East Portland, Oregon, have taken the contract for the bridges on fourteen miles of the new Portland & Willamette Valley R. R., from Dundee to the Tualatin river. There were fifteen bids, all from parties on the Pacific coast.

So unfortunate has the L., N. A. & C. R. R. been with the bridges in times past that within the last few months every old bridge on the road has been replaced with a new one or thoroughly rebuilt.

The Providence & Worcester R. R. Co. is making extensive repairs on its bridges and roadbed in Valley Falls, R. I.

At a meeting of the county commissioners, held at Breckenridge, Minn., for the purpose of considering bids for the contract to build the drawbridge across the Red river, between McCawleyville, Minn., and Abercrombie, Dak., there were eight bids. The successful one was that of Contractor Hewitt, of Minneapolis, who offered to build the bridge for $4,725, and the approaches for $390.

Market Report of Engineering Materials.

New York April 29, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	1.95c @	2.10c
" steel	2.35 @	2.45
Tees	2.35 @	2.40
Beams and channels, American	3.0 @	
Tank Plates	2.15 @	2.20
Shell Plates	2.4 @	2.5
Steel plates, Tank	2.5	
WROUGHT-IRON PIPE. PITTSBURG.		
Butt welded, black Discount	42½ @	45
" " galvanized "	32½ @	35
Lap welded black "	60 @	62½
" galvanized "	42½ @	45
Boiler tubes "	55	
RAILS.		
Steel (large lots at mill)	$35.00	
Old rails	19.00 @	
Old rails, steel	22.00 @	23.00
R R. spikes	2.20c @	2.40c
R R. splice-plates	1.75 @	2.00
R R. track bolts, square nuts	3.00	
Barb-wire fencing, galvanized		5.00
" painted		4.00
Corrugated iron		
Nails		
Iron, per keg	2.20 @	2.30
Steel do.	2.55 @	2.60

METALS.

COPPER.		
Lake Superior	$11.25 @	11.30
Other Brands	10.00 @	10.12
LEAD.		
Com. Domestic	4.70 @	4.80
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	$5.50 @	5.70

BRICK.

Cargoes (afloat)		
Haverstraw per M.	8.50 @	9.00
Fishkill		
Up-River	8.25 @	8.75
Jerseys	7.50 @	7.75
Long Island		
Pale	5.00 @	
FRONTS.		
Croton, red	12.00 @	15.00
" dark	12.00 @	15.00
" brown	11.00 @	14.00
Philadelphia pressed	24.00 @	25.00
Trenton "	24.00 @	25.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English	65.00 @	130.00
" American	85.00 @	120.00
Fire brick	24.50 @	55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.80 @	$3.00
BAETJER & MEYERSTEIN:		
Hanover Portland	2.60 @	2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
K. B. & S.	2.55 @	3.00
BROOKS, SHOOBRIDGE & Co.	2.45 @	2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.65 @	2.90
K. B. & S. "	2.75 @	2.95
Stettiner, German	2.65 @	2.85
Lagerdorfer, "	2.45 @	2.75
Fleve, A 1, Belgian	2.35 @	2.50
Roman	2.75 @	3.00
Keene's Coarse	4.75 @	5.50
" Fine	7.75 @	8.50
" Superfine	8.50 @	10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	$2.40 @	2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65 @	3.10
HUDSON RIVER CEMENT Co. Rosendale		1. 0
JOHNSON & WILSON:		
Saylor's American Portland	2.15 @	2.40
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20 @	2.40
Improved "Union"	1.25 @	1.50
Union	1.10 @	1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse	4.50 @	5.00
" Fine	8.00 @	10.00
" Portland	2.45 @	2.85
NEW YORK CEMENT Co.:		
Rosendale		1.20
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
K. B. & S.	2.35 @	2.60
STANDARD CEMENT Co		
E. THIELE:		
Dyckerhoff	2.90 @	3.25
UNITED STATES CEMENT Co.:		
Windsor	1.00 @	1.10
Standard		1.15
Cal'd 's Portland	2.15 @	2.40
UNION AKRON CEMENT Co.:		
Akron "Star" brand.		

ASPHALT.

ROCK.		
Prices range per ton	$15.00 @	20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50 @	$3.50

LIME.

Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	.95 @	1.00
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95 @	1.00
" " No. 2 "	0.75 @	0.85
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " "		
Brown stone, Portland, Ct. "	1.00 @	1.35
" Belleville, N. J.	1.00 @	1.35
Granite, rough	0.45 @	1.25
Common building stone per load	2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @	3.00

SLATE.

Purple roofing per square	6.00 @	7.00
Green "	6.00 @	7.00
Red "	15.00	
Black Penna. (at New York) "	4.50 @	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00 @	20.00
" Choice "	65.00 @	70.00
Tally plank, 1¼ in. 10 in. dres'd, each.	.44 @	.50
Tally boards, dressed com. "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 3 in. dressed "	.43 @	.45
Timber per M.	20.00 @	22.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2¼ × 4 to 4 × 6 in	.16 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00 @	40.00
YELLOW PINE, Girders "	25.00 @	30.00
Dressed flooring "	28.00 @	35.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	5.75 @	6.00
LATH, Cargo rate "	2.00 @	2.25

PAINT.

Lead, white, American dry per lb	.04¾ @	.06
" " in oil pure "	.06¾	
" English, B. B. in oil "	.08¾ @	.08¾
" Red, American "	.05¾ @	.05¾
Litharge "	.05 @	05½
Venetian red, American "	.01 @	.01¼
Indian red "	.05 @	.10
Vermillion, American lead "	.10½ @	.12½
Paris green "	.18 @	.20
Umber, Amer. raw and powdered per lb.	.01¾ @	.01¾
Drop black, Amer. "	.07 @	.13
" Eng. "	.11 @	.13
Chrome green	.05 @	20
Oxide zinc, American "	.03¾ @	.04
" French "	.06 @	.08

Trade Notes.

IT is reported that a new car shop is to be started at Dennison, O. Address Charles B. Street.

THE New Albany, Ky., rail-mill has received a contract to construct the material for the cable railroad at Kansas City, Mo.

THE Rogers Locomotive Works, Paterson, N. J., have several orders in hand.

THE Joliet Steel Company is about to increase its capital stock from $2,000,000 to $3,000,000, with a view of extending its operative capacity.

A CONTRACT has been awarded for building a 40-ton pipe pit at the Chattanooga Pipe Works. This will give the factory seventy tons capacity per day.

THE mineral output of Colorado in 1885 was as follows: Gold, $5,000,000; silver, $13,500,000; copper, $700,000; lead, $3,361,000; total, $22,561,000.

AT Ashland, Wis., explorers are at work on lands adjoining the South Superior Iron Company's property, on the range, and have already found a fine quality of hard hematite ore.

THE L. N. A. & C. R. R. Co. has decided to put in 150 miles of new steel rails weighing sixty pounds to the yard. The Joliet, Ill., steel-rail mills are to furnish the rails.

PITTSBURG, April 22.—Since the introduction of natural gas into this city the output of the mills and factories has been increased 20 per cent., a large number of new plants have been built, and nearly 10,000 additional men given employment

THE Phœnix Iron Company, Phœnixville, Pa, has begun the erection of a girder shop for bridge-building purposes. The shop will be capable of turning out about 40,000 tons of bridge iron a year.

THE Portland Company in Portland, Me., is building four heavy passenger engines and one freight engine for the Maine Central R. R. The locomotives will be the heaviest yet put on that road, and will be run upon the Mt. Desert fast freight.

THE Pittsburg Steel Casting Co., of Pittsburg, is making the castings for a very large testing machine for the Union Bridge Co., Athens, Pa. The steel cylinder alone will weigh over four tons. It will have a capacity of 1,200,000 pounds.

THE Cambria Iron Co., of Johnstown, Pa., has formed a joint-stock company, with $500,000 capital, to work valuable manganese ore in Arkansas, near Batesville. The company will be known as the Johnstown Manganese Iron Co. A railroad thirteen miles in length will be built immediately to connect with the mines.

THE Queen City Bridge & Steam Forging Co., of Cincinnati, reports trade in most lines of their manufactures fairly active, with their bridge department not operating altogether full. Their foundry is now engaged in getting out, on contract, a large order of yokes for the new Gilbert Avenue Cable Railway.

GORDON, Strobel & Laureau, of Scranton, Pa., have just closed contracts for three more blast furnaces, one for the Pratt Coal & Iron Company, one for Alice Furnace Company of Birmingham, Ala., and one for the Vulcan Furnace Company of St. Louis, making thirteen plants which they now have contracts for.

THE experiments in the manufacture of steel from the Cranberry, N. C., ores have been commenced at the new steel works of the South Tredegar Iron Co. in Chattanooga, Tenn., and have been so far successful. Should these experiments succeed, the Roane Iron Co. will probably also start up its works in Chattanooga, making Bessemer steel from the Cranberry pig iron.

PITTSBURG, April 20.—John Jarrett, ex-president of the Amalgamated Association of Iron and Steel-workers, and Andrew Carnegie, the millionaire iron master, have in contemplation the organization of an immense co-operative store and bank. The stock is to be taken by members of labor organizations exclusively, and no person will be permitted to have more than $200 worth of the stock. If the scheme is successful, stores will be started in a number of cities in different parts of the country.

THE Vulcan Iron Works, of Toledo, O., are now running full with especially heavy orders in hand for their "Giant" excavator. Their new mast which gives straight hoisting chain from point of crane to hoisting drop, has added a new and valuable feature to the "Giant." They have trade with Mexico and Brazil, the Pacific slope and throughout the United States. The company reports business better, prices better, and railway inquiry for car castings brisk.

THE Smith Bridge Co., Toledo, O., are running full and orders are better than a year ago. They consider the outlook for railway and other bridge construction very fair. This company has solved a difficult problem with bridge builders, i. e., to produce a perfect eye bar. They have now succeeded in making a "perfect" steel eye bar. They have in the last few months practically reconstructed their plant, having added some special machinery adapted for bridge construction.

A NEW industry has been established in Carondelet, Mo., by Theodore and John Plate. It consists in the coating of sheet iron or steel with copper, brass or bronze. Samples furnished from the works show a very superior order of copper-plating, the coppe having apparently become an indestructible part of the surface of the sheets. The output of the works is as yet small but the prospects are that it will be greatly augmented in response to a demand for the coppered sheets, as a substitute for galvanized iron. The present cost of preparing the sheets is somewhat in excess of the cost of galvanizing, but improved facilities and experience will no doubt bring about economies in this particular. The Missouri Pacific Railroad Company has furnished specifications for the lining of 100 cars with the coppered sheets, instead of with galvanized iron.

THE Boston correspondent for the "Northwestern Lumberman," under date of March 27th, says, in commenting on the future demand for lumber in that city, that the contractors who make a business of erecting houses on speculation are in a peculiar position, as they find it difficult to secure firms who will sub-contract for any extensive job, from the fact that the price of labor is as yet very uncertain, and the margins of profit are so small even with the shrewdest management that it is extremely unsafe to agree to do any large amount of work on that basis, hence many contractors who had contemplated to do considerable work this year will change their plans and do as little as possible. This same conclusion is also being followed by many private individuals who had decided to build houses. A dealer said that all men to whom he sold lumber are undecided as to what work they will do this year and refuse to buy, and he is satisfied that the result of this agitation will prevent the sale of millions of feet, and will make much less demand for labor.

THE following is the average annual capacity for locomotive construction:

Name and location of works.	Annual capacity.
Pennsylvania:	
Baldwin Locomotive Works	600
Pittsburg Locomotive Works	104
National Locomotive Works	30
H. K. Porter & Co.	52
Dickson Mfg. Co.	96
New York:	
Schenectady Locomotive Works	144
Brooks Locomotive Works	100
New York Locomotive Works	100
New Jersey:	
Rogers Locomotive Works	360
Grant Locomotive Works	156
Cooke Locomotive Works	180
Rhode Island:	
Rhode Island Locomotive Works	156
Massachusetts:	
Taunton Locomotive Works	96
Hinckley Locomotive Works	144
Mason Machine Co	72
New Hampshire:	
Manchester Locomotive Works	144
Maine:	
Portland Locomotive Works	72
General:	
Railroad shops	250
Total	2,856

The Fargo & Northern R. R. Co. has been incorporated in Dakota. Charles Sweatt, President; J. S. Woodruff, Vice President; W. B. Douglas, Secretary; R. S. Tyler, Treasurer. The object of this company is to build one or more railroads northeast of Fargo in the interest of the trade of the city.